SCIENCE.

FRIDAY, APRIL 24, 1885.

COMMENT AND CRITICISM.

THE WORK of the commissioners of the state reservation at Niagara has advanced to the point that the bill making the appropriations for taking the necessary lands has passed the legislature, and only awaits the signature of the governor. There comes a suggestion from Mr. S. A. Lattimore of Rochester, to the effect, that, in the event of the acquisition of the land around the falls by the state, a museum should be erected there, to be devoted exclusively to the elucidation and explanation of the physical and geological history of the place. Its walls should be built of rocks from local quarries; its rooms should contain only such objects as possess a true scientific value; mere curiosities, and specimens from other regions, should be carefully excluded; every thing should have as direct a bearing as possible on the history of the falls. Samples of the famous rock series from the gorge, with its fossils and minerals; plants and animals from the neighboring country; and maps and models of the falls and the chain of great lakes, — constitute the chief parts of the museum as described by its projector.

The plan is certainly a good one, and may be successfully carried out at no great cost. Such a museum could be made attractive as well as instructive, and few visitors would fail to see and profit by it. The exclusion of curiosities, such as too often encumber museums, is well advised; but to our mind the collection needs two additional elements in order to reach its full value, — waterfalls and gorges in other parts of the world should be illustrated by views, maps, models, and descriptions, so that the inquiring stranger might gain a true estimate of Niagara; and the exhibit should be described in some detail on the labels. Few collections that are open to the public have sufficient explanation accompanying them; and visitors are, as a rule, forced to be discontented with mere names instead of reading well-stated meanings of what they see. Such descriptive labels might even be supplemented by brief papers prepared by specialists, and accessible to the small share of visitors who care to make some study of the place. We commend Mr. Lattimore's project to the careful consideration of the commissioners.

ON APRIL 16, Gov. Harrison (who is now *ex officio* a member of the Yale corporation, and who was, until his election as governor, one of the corporators elected by the Yale alumni) signed the bill by which the state of Connecticut terminated its contract with the Yale observatory for furnishing standard time. The legislation on this subject has had a history which strikingly illustrates the danger of having scientific institutions depend on popular assemblies for annual appropriations for their support. When the 'standard time' law was enacted, in 1881, Connecticut had its full quota of local times. The confusion in that manufacturing and busy community was so marked, that the Yale observatory had comparatively little difficulty in guiding an exceptionally able legislature to a unanimous decision in regard to establishing a standard time. The observatory, with an admirable plant, has conducted the service with uniform efficiency and accuracy.

To the surprise of its officers, some two months since, the appropriation committee reported to the Connecticut house of representatives a bill repealing the appropriation by amending the original act. This report was made without a single hearing on the merits of the case. When it became known that the committee intended to push the report, the friends of the observatory, and those interested

in the service, made a determined effort to defeat it, which was only so far successful as to defeat it in the senate once of the three times it was there considered after leaving the house of representatives, where it was passed by a small majority. By some it is believed that the whole proceeding originated in republican party warfare against the 'mugwumps' and free-traders at Yale college. This much is certain, that the ordinary friendliness which might exist between the college and the state was lacking in the case of many members of the general assembly. The governor, who was known to be personally strongly in favor of the observatory service, found himself in a delicate position, and doubtless, in the absence of any thing unconstitutional in the repeal, took the only course open to him which would be open to no misconstruction.

PROFESSOR JAMES GEIKIE of Edinburgh contributes a very valuable article on the physical features of Scotland to a recent number of the new Scottish geographical magazine. It is illustrated by a beautiful little orographical map of Scotland by J. Bartholemew, in which the physical relief is finely brought out. Commenting on this, and on the excellent maps of the Ordnance survey on which it is based, Professor Geikie concludes with the following paragraph: —

"With such admirable cartographical work before them, how long will intelligent teachers continue to tolerate those antiquated monstrosities which so often do duty as wall-maps in their schoolrooms? Surely more advantage ought to be taken of the progress made within the last thirty or forty years in our knowledge of the physical features of our country. It is time that the youth in all our schools should be able to gather from their maps an accurate notion of the country in which they live; that they should see the form of its surface depicted with an approach to truth, and learn something more than that so many principal rivers flow in so many different directions. With a well-drawn and faithful orographical map before him, the schoolboy would not only have his labors lightened, but geography would become one of the most interesting of studies. He would see in his map a recognizable picture of a country, and not, as at present is too often the case, a kind of mysterious hieroglyphic designed by the enemy for his confusion."

We copy this with hearty emphasis and approval, for it points out precisely the difficulty under which our scholars labor. But while in Great Britain, and in continental Europe generally, the surveys from which good school-maps might be constructed are already well advanced or completed, in our country they are either neglected or only just begun; and it is even still almost always a difficult matter to persuade state legislators, from whom appropriations flow, that good maps are needed. It is no exaggeration to say that the educational value of such maps as are now in preparation in New Jersey and Massachusetts is alone more than their cost to the state; and we shall watch for the better teaching in the common schools, that must follow their completion, with as much interest as for the inception of similar work in other states.

LETTERS TO THE EDITOR.

Centrifugal force and the supposed polar ice-cap.

IN your issue of March 27, you publish an article by Dr. Franz Boas, upon 'Mr. Melville's plan for reaching the north pole,' in which there are some statements that should not pass unchallenged. They occur in the discussion of the effect, upon the supposed 'ice-cap,' of centrifugal force due to the earth's rotation.

The formula for calculating the effect of centrifugal force is a well-known and simple one, $C = \frac{wv^2}{32.16r}$, in which v = velocity in feet per second, r = radius in feet, w = weight of the mass acted on, and C is the centrifugal force in pounds. Apply this to latitude 85°, r = 345 miles, or 1,821,600 feet, and $v = 132\frac{1}{2}$ feet per second.

Then, if we take a cubic foot of ice, $C = \frac{1}{60}$ of a pound, or about one hundred grains of pull, away from the pole, southward, upon each cubic foot of ice, — a force which is approximately one four-thousandth of the weight of the body acted upon, instead of being thirty thousand times that weight.

Whether the ice is one foot thick, or one hundred feet in a single block or in a broad or heaped mass, makes no difference in the result; for each unit of mass acts independently of each other unit. So far as centrifugal force goes, it could neither make nor mar the hypothetical 'ice-cap.'

E. W. WETMORE.

Essex, Conn., April 11.

In the controversy between Mr. Melville and Dr. Boas respecting the supposed polar ice-cap, both parties appear to take an erroneous view of the action of 'centrifugal force.'

The notion of centrifugal force, like other examples of the so-called 'force of inertia,' is used simply to enable us to treat a body whose particles are not all moving uniformly in straight lines as in statical equilibrium. Thus, by imagining a force following a certain law of intensity acting outwardly from the earth's axis, in co-existence with the force of gravity, we may regard the earth as a stationary body, subject to these forces. It is the resultant of these forces which we commonly regard as the force of gravity; and, the earth having assumed the form of equilibrium, with a surface everywhere normal to this resultant force, there is no more occasion to consider the centrifugal force as acting independently. But, if we choose to do so, then we must regard the radial force of gravity as acting also; and the centrifugal force acting at any point is then balanced by the force which would, if the earth were not in rotation, reduce it to a spherical form. Thus the centrifugal force can create no tension in an ice-cap, and there is nothing in the nature of the forces acting to interfere with the existence of a continuous ice-cap round the pole, whether symmetrically situated or not. Of course, if a mass of ice were piled up at the pole above the spheroidal surface of equilibrium, lateral pressure would exist, but only in the same way that it would under like circumstances in any other part of the earth; and, wherever this pressure met insufficient resistance, the ice would 'flow' away in glaciers, just as it does from any elevated region of the earth's surface. WM. WOOLSEY JOHNSON.

Digestion experiments.

An agricultural experiment-station has to contend against the prejudices of a public which demands speedy work and preposterous generalizations rather than accuracy. When a station, therefore, does do work of a scientific character, it is especially desirous of recognition on the part of science, as such recognition not only brings encouragement to the workers, but also has an influence upon the public to educate toward better expectations and wiser demands. What suggests this remark is an article in *Science*, April 10, entitled 'Errors in digestion experiments,' from which the reader would infer that Professor Armsby's experiments upon digestion were the only ones of that character which have been made in this country. As a matter of record, however, I presume the New-York agricultural experiment-station, in its Bulletin No. lxxxv., May 17, 1884, is entitled to the claim of having first published the results of a trial upon the digestibility of a ration in part composed, in the one case, of corn-fodder, and, in the other, of the same material ensilaged. In the forthcoming report of the station for 1884, the figures of these trials, as well as of others, will appear in considerable detail.

E. LEWIS STURTEVANT.

Geneva, N.Y., April 13.

Volcanic dust from south-western Nebraska.

There were received at the national museum a few weeks since, from a gentleman in Nebraska, samples of a fine white and very sharp dust, supposed by the sender to be of geyser origin. The deposits from which the samples were taken are stated to be semicircular in outline, from four to ten feet in thickness, and of varying grades of fineness, situated on the banks of small streams that flow into the Republican River. The precise localities given are, Furnas county, two miles south of the Republican River, in sections 9 and 10, township 3, north range 21 west; and Harlan county, one mile south of the river, sections 10 and 11, township 2, north range 20 west; though the writer states that he has also found similar deposits in Kansas, Colorado, and Wyoming.

An examination of the dust with a microscope shows at once that it is not of Geyser origin, being composed almost wholly of minute fragments of pumiceous glass, with only very rarely a small particle of hornblende. Portions of a coarser deposit, associated with the dust, contain numerous rounded fragments of felspar, a part of which at least is triclinic, as shown by twin striations, and hornblende and magnetite particles. The deposits are therefore, without doubt, volcanic dust and sand, owing their present arrangement to the assorting agency of water and atmospheric currents; and their mineral composition would indicate that the corresponding lava was an andesite.

The matter is deemed of sufficient importance to mention here, from the fact, that, so far as I am aware, no deposits of dust of this nature have heretofore been reported east of the Rocky-Mountain region. GEORGE P. MERRILL.

U. S. nat. museum, April 13.

Hastings's theory of the corona.

Your reviewer of the 'Report of the eclipse expedition to Caroline Island' has, by an unfortunate expression, so entirely misrepresented my theory regarding the solar corona, that a correction is necessary. Instead of supposing that the "coronal phenomena may be fully accounted for by applying the well-known principles of diffraction," as he asserts, I demonstrated that these principles completely fail to account for any part of them. What I did do was to prove that Fresnel's theory is not applicable to the case where both source of light and screen are at an indefinitely great distance from the observer; for then the implied constancy of phase of the wave-surfaces certainly does not exist. This limitation of the theory of diffraction does not seem to have been noted before; and it necessarily implies a distribution of light about the moon during a total eclipse which may be like that of the corona. Assuming that the corona is so formed, I show that all its characteristics (with the exception of the occasional filamentous structure, where the indication of the theory is doubtful) may be explained naturally and easily, even the polarization and absence of the Fraunhofer lines.

I may venture to describe briefly two observations of interest given in detail in the report, since they have not been noted in the review, and have been published only in the report. The first is Professor Holden's observation of the so-called 'shadow-bands' seen just before and just after totality, and which so strikingly suggest a diffraction phenomenon. No one before him, so far as I know, has determined with any useful precision their azimuth, nor had it before been recognized that they move in opposite directions at the two epochs. That their azimuths are those of planes tangent to the sun at the points of second and third contacts, is perhaps not of such immediate interest as the observed reversal of motion, since the latter feature excludes the more favored explanation which makes them shadows.

The other point is the proof that the '*b*' group must be regarded as belonging to the same category as 1474 K, the hydrogen lines H and K; namely, that of bright corona lines. This renders it extremely probable that all the brilliant as well as high chromospheric lines are also coronal lines. The fact must be regarded as a strong indication in favor of the theory advocated. C. S. HASTINGS.

New Haven, April 13.

THE CONSOLIDATION OF THE GOVERNMENT SCIENTIFIC WORK.

Our readers are already aware that the congressional committee appointed to consider the organization of the surveys and other scientific work of the government made no report at the last session of congress. The commission was, however, continued as a commission of the succeeding congress. The expired places of Messrs. Pendleton and Lyman were filled by new appointments from the members elected to the next congress. A meeting of the reorganized body has been held, which adjourned until next November without coming to any definite conclusion respecting the measures to be finally proposed. Before adjourning, Major Powell was authorized to make public the testimony which he had laid before them on different occasions, and which covers most of the points to be acted on by the commission.

Major Powell's statements naturally include a very detailed account of the methods, work, organization, and expenses of the survey over which he presides. He also submitted his views upon the best method of consolidating the geological and coast surveys with the other scientific bureaus of the government. This is the really important question before the commission, since upon its decision must turn the general efficiency of the government scientific service for a long time to come. The necessity for some such consolidation is strongly felt in congress as well as outside of it. The one danger to be avoided is that of some hasty plan being adopted, which may suit the exigencies of the moment, but may not work well after those exigencies have passed.

One very strong reason for placing the scientific bureaus under one head, or in one department, is that scientific work has many features peculiar to itself, which require it to be conducted upon principles different in some respects from those which prevail in other departments. The head of an ordinary bureau or department of the government, and indeed every man in public life, is conversant only with offices and duties which there is no serious difficulty in satisfactorily filling, with the aid of that knowledge of men and of the world which he acquires through his daily intercourse with others. Such a person is accustomed to finding scores of candidates for every office, from whom a suitable selection is always possible. The idea of an office for which there may be no applicants, or, if there are any, for which it is morally certain that the applicants are all unfitted, no matter how good their recommendations, is one which he finds it difficult to assimilate. Indeed, in the case of the purely scientific office, the ability to find the proper men must be a part of the life education of the man who is to make the selection. It is safe to say that the best officers who have served in the coast and geological surveys are men, who, under the ordinary system of government appointments, would never have been heard of in connection with the positions which they so ably fill.

The same thing is true of the administration of a scientific bureau. No uniform system can be devised which will apply to all the details of a great scientific work. When we go beyond the regular routine operations, it is needful that the duties shall be accommodated to the man, and that in many cases a larger measure of liberty shall be allowed the latter than could be tolerated in the usual operations of a government department. All this requires, on the part of the administrative head of the department, an appreciation of the subject which can only be acquired by long familiarity. If the head is not specially charged with mastering the peculiar methods of administration thus rendered necessary, the chances are that he will fall into one of two opposite errors: either he will leave the heads of the scientific bureaus to manage things in their own way, without any administrative control whatever, or he will exert his authority in such a way as to endanger the efficiency of the work. The former is undoubtedly the more natural course to take, and thus arise the friction and duplication of work which so seriously impair efficiency and discipline.

Yet another feature of government scientific

work is that it is far removed from that public criticism which is so conducive to efficiency in other branches of the service. It is difficult to conceive that such a state of things as was exhibited by the surveys of the territories ten years ago could have existed in the performance of any work with which the public were conversant. At that time we had at least two independent surveys of the territories, prosecuted by different departments of the government, and with nominally different objects, but which were practically identical in their actual work. The officers in charge were independently surveying and mapping the very same regions. At the time that Hayden's Atlas of Colorado was published, Capt. Wheeler was engaged in surveying Colorado, and making maps of the territory substantially identical in their objects with those of Hayden. Both surveys were intended to cover the whole public domain.

Nothing quite so bad as this is likely to arise in the future. But there is still room for much duplication of work, as well as waste through competition in getting possession of particular fields. As a general rule, the head of a department is quite ready to approve of any extension of work which any of his bureau officers may propose, and has not always time to learn that the same work is being done, or might be better done, by some other department. The annual provision which congress has got into the habit of inserting into the appropriations for the signal-office — "provided that hereafter the work of no other department, bureau, or commission authorized by law shall be duplicated by this bureau" — is not quite satisfactory: it leaves open the question whether any proposed work is "the work of any other department, bureau, or commission."

The report of the National academy of sciences proposes to remedy some of these evils by placing the general policy of the scientific bureaus under the control of a mixed commission, organized somewhat after the plan of the Lighthouse board. If the bureaus are to remain separate, we see no better plan than this for securing the proper co-ordination of their work; but Major Powell points out certain difficulties in the way of its successful operation. His strongest objection is, that subordinate officers of various departments would have to practically control the work, thus reducing the heads of the departments to channels for transmitting instructions. If the proposed commission were to assume any administrative control of the work, this objection would certainly be fatal. The official responsibility of the head of a department for the work of his bureaus should not be interfered with. But the report of the academy expressly disclaims charging the commission with any administrative responsibility. Its sole function was to prescribe the policy of the bureaus; that is, to decide what each one should do, and what each one should refrain from doing: the whole execution of the work decided upon being left completely in the hands of the regular authorities. We see no reason why this should be 'irksome' to the heads of the departments. We also feel that Major Powell assigns undue importance to the influence of the single military officer proposed by the academy as one of the nine members of the commission. It is not so clear to us, as it seems to be to him, that one such officer could leaven the whole lump of the commission with ideas of military discipline unsuitable to the conduct of a scientific bureau.

But however favorably we may view the plan of this commission, we must hold that the consolidation of the bureaus under a single head, or in a single department, would give far more assurance of efficiency. Especially is this the case with the two national surveys. Their work now covers the same fields, and their mutual interdependence is such that they should work under a common plan. The geological survey requires for its proper execution certain geodetic and astronomical work, the execution of which is not within the proper province of the geologist. It is absolutely necessary that this geodetic and astronomical work should be so planned and executed as to meet the wants of the geological survey, and

at the same time it is the proper function of the geodetic survey. We are informed by Major Powell that he makes use of all the coast-survey results so far as they are available, but he does not indicate what fraction of his labor is thus saved; and it goes without saying, that he has no authority, directly or indirectly, to require that the coast and geodetic survey shall do any thing which he may want done.

Among the suggestions made by Major Powell was one that all the scientific bureaus should be placed under the general direction of the regents of the Smithsonian institution. This does not appear to have been considered practicable, and was not further urged by the director himself. One of the possible plans is to place all these bureaus under the interior department. The principal objection to this course is that that department is already overloaded with work, so that its head could not give the proper consideration to the subject. Yet this is the simplest course, and would certainly be an improvement on the present state of things. The more effective course would be to form a separate department of science and public works. To this there seems to be no positive and serious obstacle, except the difficulty of getting any measure of the sort enacted into a law. The question whether the head of the department should be a scientific expert or a public administrator, is an ulterior one, which need not be discussed at present. In the latter case, the question of its being regarded as a cabinet office would arise. There will be little hesitation in deciding this question in the negative.

In a future number we hope to discuss other testimony taken before the commission, and the proposition which appeared in the supplement to our last number.

THE BOTTLE-NOSE DOLPHIN, TURSIOPS TURSIO, AS SEEN AT CAPE MAY, NEW JERSEY.

This is the commonest dolphin on our Atlantic coast, occurring from Greenland to at least as far south as Florida; and Professor Flower is inclined to believe that it is cosmopolitan. The dolphins are very abundant along the shore of New Jersey, passing and re-passing close to the beach in schools of greater or less magnitude. The fishermen state that they usually pass around Cape May City into Delaware Bay upon the rising tide. Their movements would appear to be somewhat uncertain, however; for we lay all the morning at Hereford Inlet, expecting to see them approach from Seven-mile beach, and failed, but found them in the afternoon at Cape May point, from which we had started. It seems probable that they come into Delaware Bay from the southwest.

The school surrounded at Cape May point apparently comprised about thirty individuals. They showed no fear at the approach of the steamer. Upon striking against the large net in which they were impounded, they showed no disposition to leap over it, but attempted to make their escape by diving. Observations on this point, however, were brought to a speedy close from the fact that three specimens, becoming entangled in the net, rolled it up from the bottom, and thus allowed the remainder of the school to make their escape.

All the three specimens secured were females: two were adult, about two hundred and sixty centimetres in length, and the third a young animal about a hundred and twenty centimetres in length. On compressing the sides of one of the larger specimens, milk issued in a fine stream from the mammae. When collected in a bottle, it appeared of the color and consistency of cream, was without perceptible odor, and possessed the flavor of cocoanut-milk.

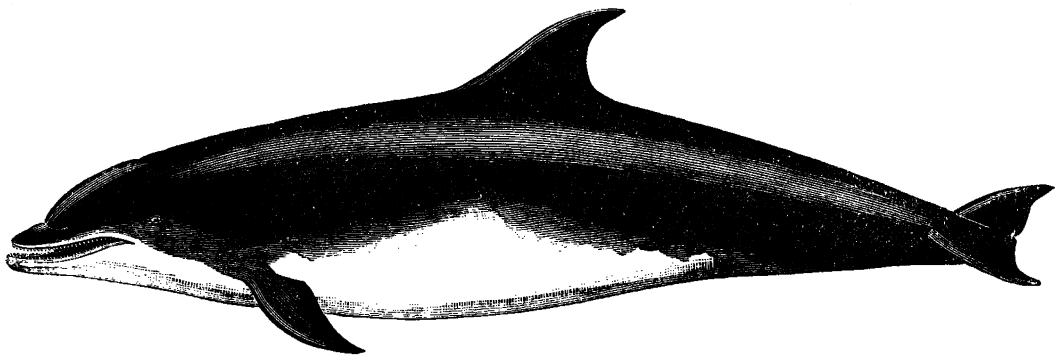
I placed some in a bottle to bring to Washington for analysis, but it soured in transportation on account of the warmth of the weather, and forced out the cork. The fishermen stated that the specimen which furnished the milk was followed about by the younger animal. Although I was not near enough to verify this observation, it seems to me very plausible. The teeth of the calf were barely visible above the gums, and it showed other signs of youth. I am inclined to believe that it was born in the spring of 1884, and that the time of weaning was not far distant when it met its death.

Upon opening the abdomen of the second adult specimen, we found a foetus about twelve centimetres in length. The stomach of both adults contained simply a few bones and one or two skulls of a fish which appeared to be

the common gurnard (Prionotus carolinus). The specimens having been drowned, the lungs were filled with water. The fishermen state that this species cannot remain under water more than four or five minutes.

The color of the back in the specimens secured was a light plumbeous tint. It shaded rather suddenly at the middle of the sides into the pure white of the under parts. I was informed that the depth of the color of the back varied considerably in different specimens, and it deepens very rapidly as soon as life is extinct, especially if the specimens lie in the sun.

FREDERICK W. TRUE.
National museum, Washington.



THE BOTTLE-NOSE DOLPHIN, TURSIOPS TURSIO (AFTER FLOWER).

BUTTER.

THE work of the U. S. bureau of agricultural chemistry shows that the percentage of water in a good butter should not exceed twelve. In thirty-four analyses the highest percentage of water found was 14.51, and the lowest 7.34. It is naturally in the interest of the seller to incorporate as much water as possible in the butter. But, if all butter should be legally condemned which should contain more than ten per cent water, the tendency to 'underwork' the butter would be speedily corrected. In one instance a report of an analysis of foreign butter gave a percentage of water of 35.12. The quantity of salt in a butter should depend solely on the taste of the consumer. I doubt very much whether the addition of a few per cent of salt helps preserve the butter. It is therefore a condiment only. In eighty-four analyses the highest percentage of salt found was 6.15, and the lowest 1.08. Two per cent is a fair mean of the salt usually present. Much butter is now made without any salt at all, and the use of such butter is rapidly increasing. Salt is cheaper than butter, and there is therefore a tendency to use it to the maximum endurable by the eater. But butter without salt will hold more water; and, as soon as this fact is generally known, sweet, moist butter will be more common than the dry, salt article. It would be a good thing if all the caseine could be washed out of the butter, but this is impracticable. Albuminous bodies decay more easily than all others, and butter with a great deal of curd in it is very hard to keep sweet. Of all the constituents of butter, this is the most difficult to estimate. Oleomargarine butters contain no curd, unless they have been churned with milk, and even then not a great deal. If butters do not have more than one per cent of curd, they may be accepted as having been properly prepared. Owing to the difficulty of estimating it, however, the quantity present should not be taken as a test of purity.

The fat of genuine butter is heavier than that of tallow, lard, or any of the common fats used as butter adulterants. Its specific gravity is about 912, water at the same temperature being taken at 1,000. The relative weight of tallow or lard often falls below 900. In analyses of commercial oleomargarine I have found the highest density to be 905. Of butter-fats in thirty analyses the maximum was 912.5, and the minimum 908.6. There should be grave doubt of the purity of a butter, if the specific gravity of the fat should fall below 909. For this reason the specific gravity of a butter-fat, if it be properly taken, is almost a certain test of its genuineness. The process is, however, a tedious one, and requires the greatest care and delicacy in manipulation.

The quantity of alkali required to saponify the fat is another valuable means of judging of the purity of a butter. This equivalent is an abstract number obtained by dividing the molecular weight of the alkali employed by the number of milligrams of it used in saponifying a given weight of the fat. Butter-fat contains acids (butyric chiefly) which have a lower molecular weight than oleic, margaric, and palmic acids. The saturation equivalent of a butter-fat is therefore expressed by a smaller number than if it were composed solely of glycerides of the acids with a higher molecular weight. The determination of the equivalent being an easy one, it is generally made as the first test in determining the genuineness of a butter sample. For genuine butters, this number is about 245. When it goes above 250, the samples should be regarded with suspicion. In one case of a Jersey butter very rich in butyric acid, this number fell to 239.8. On the other hand, in four samples of tallow, lard, and oleomargarine (two), the numbers were 280, 284, 282, and 281 respectively.

Pure butter contains a certain proportion of glycerides of fat acids soluble in water (butyric, capronic, caprylic, etc.). The percentage of these acids to the total weight of butter-fat is about five. In thirty analyses the lowest percentage found was 4.49, and the highest (except in one case) 5.66. In the case of the Jersey cow's butter, already mentioned, this number was 6.79. Tallow and lard have at most only a trace of these acids. In commercial oleomargarines the highest percentage found was .56, and the lowest .20. The determination of the soluble acid requires much time; but it is not a difficult operation, and it is the most certain method of determining the purity of a butter. A sample which would give no more than four per cent soluble acid would be open to condemnation. It would either be a very poor sample of genuine butter or else an adulterated article.

Pure butter which has not been melted gives, with polarized light and a selenite plate, a pure uniform tint of red or blue to the field of vision. Adulterated butter in similar circumstances always gives a mottled appearance to the field. This is a very simple and speedy qualitative test for the purity of butter, but is not sufficient in itself to definitely determine the matter.

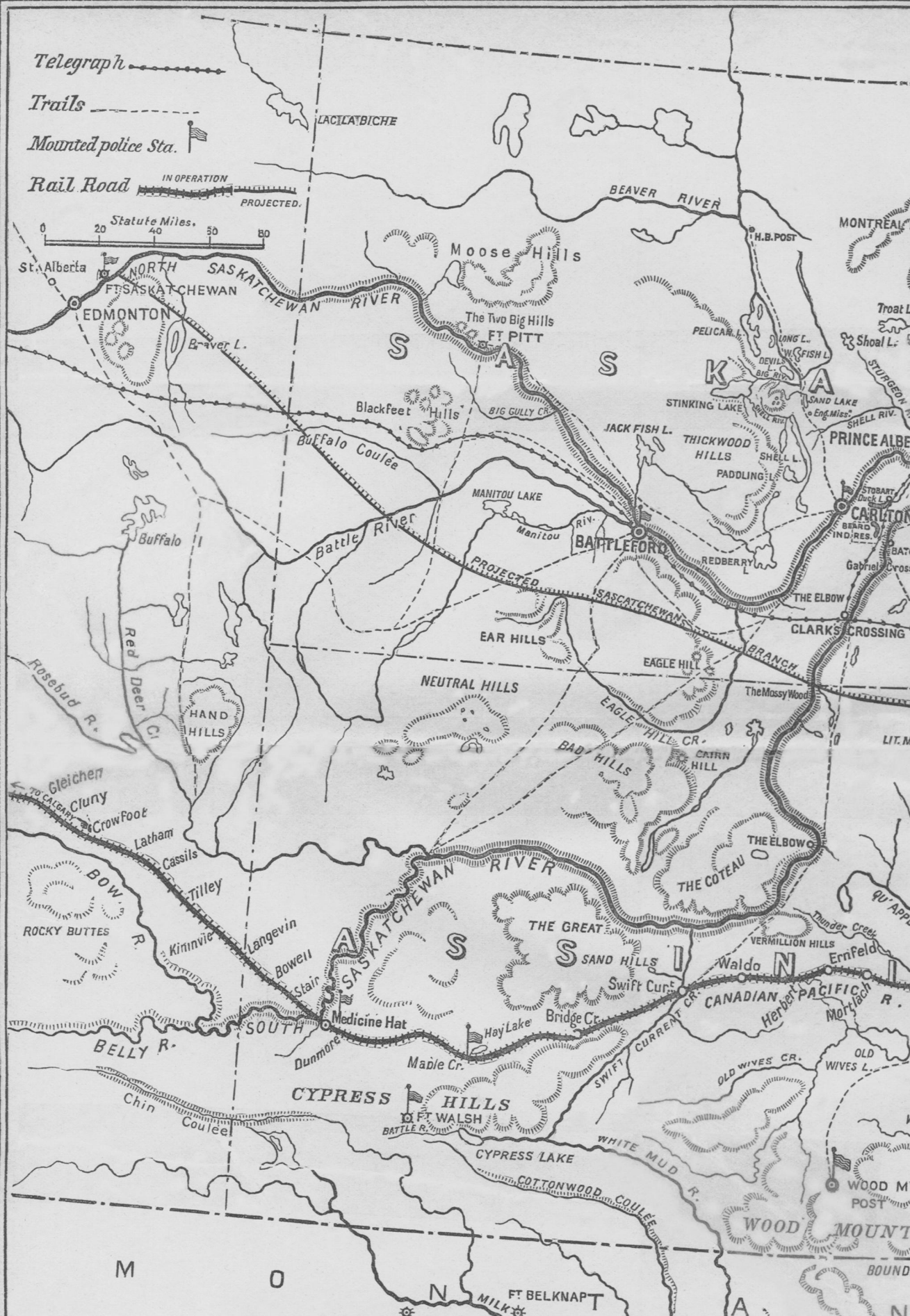
The difficulties which make the analyses of milks of little practical value are equally as great with butter. A more extensive study of their composition, however, is certain to lead to profitable results. H. W. Wiley.

THE SASKATCHEWAN COUNTRY.

The district at present attracting attention as the scene of an insurrection of half-breeds and Indians against the Canadian government is situated on the North Saskatchewan River, near the northern margin of the great plains. The vast region of plain and prairie, which occupies the whole central portion of the continent, crosses the 49th parallel of latitude — which constitutes the international boundary-line — with a width of 750 miles, but extends north of the boundary about 300 miles only, being there limited by the edge of the great northern forest which stretches, with little interruption, to beyond the arctic circle. Prairies of considerable size occur, it is true, in the valley of the Peace, but these are isolated from the great plains by wide forests. There is reason to believe that the greater part of the prairie country in Canadian territory might become permanently wooded but for the almost annually recurring prairie-fires, which are still tending to increase its area. The southern edge of the forest is, however, in the main, coincident with that of a region of abundant rainfall.

The northern border of the prairie country may be generally defined by a line drawn from the vicinity of the city of Winnipeg westward to the junction of the Assiniboine and Qu'-Appelle rivers; thence north-westward to the junction of the North and South Saskatchewan rivers; thence westward, nearly following the latter river, to Edmonton; from that point south-westward to Calgary, on the Bow; and thence southward along the eastern base of the Rocky Mountains. The total area thus outlined, which is either altogether treeless or characterized by wide stretches of prairie interspersed with scattered groves of aspen and other trees, is approximately 300,000 square miles. The southern and south-western parts of this region may be described as entirely without wood, though even there the rivers are almost invariably fringed by groves of cottonwood.

The general elevation of the plains of the Canadian north-west is very considerably less than that of the corresponding portion of the continent farther south, the mean height of the whole region above outlined being probably less than two thousand feet above the sea-level. The most pronounced inclination, however, giving direction to the rivers of this portion of the great plains, is that from the base of the Rocky Mountains to the east or north-east. The Red-River valley, which constitutes the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LACLA BICHE
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NORTH SASKATCHEWAN RIVER
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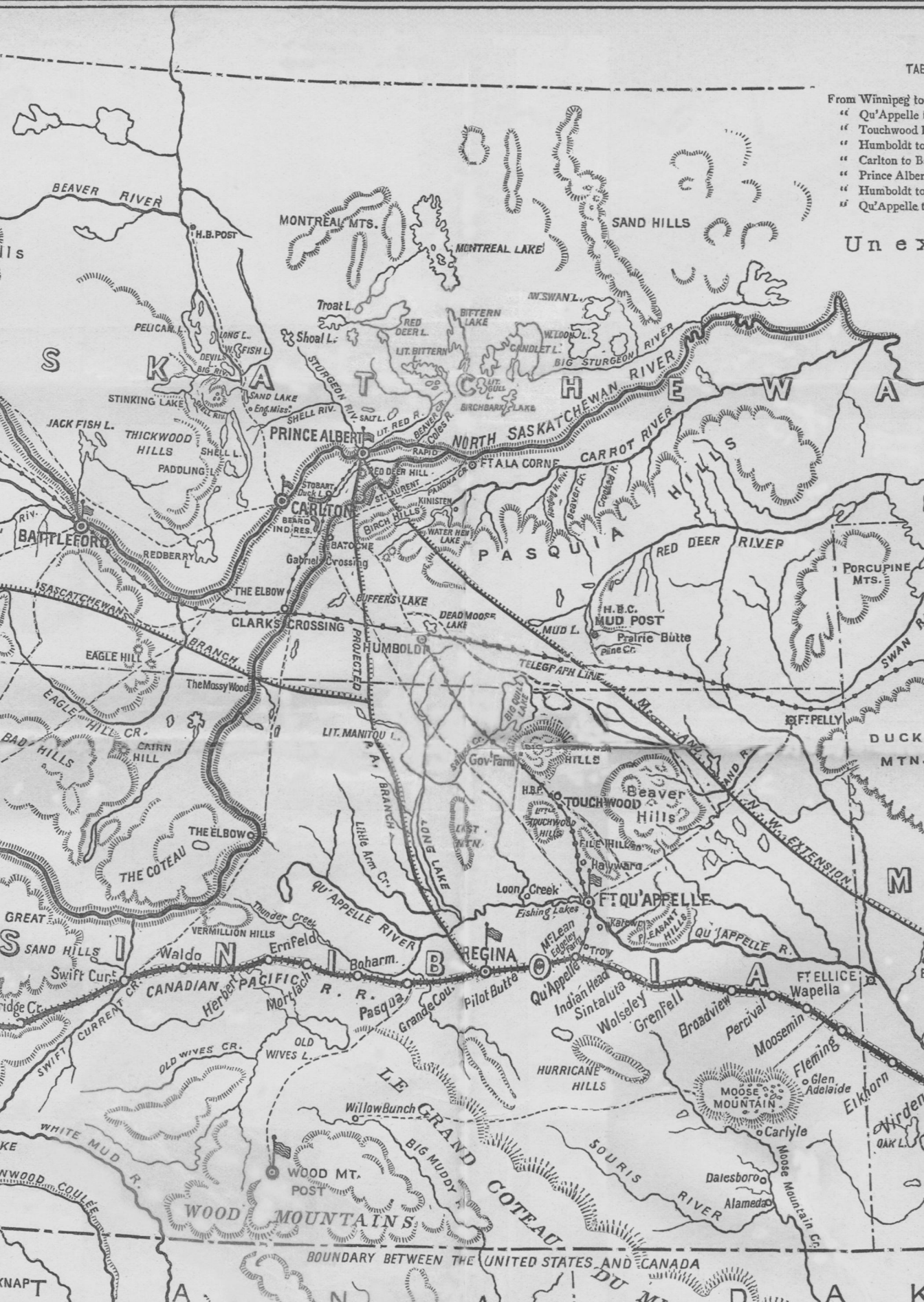
EDMONTON
Moose Hills
The Two Big Hills
Ft PITT
Beaver L.
Blackfeet Hills
BIG GULLY CR.
Buffalo Coulee
Battle River
Buffalo
Red Deer Cr.
Rosebud R.
HAND HILLS
MANITOU LAKE
Manitou Riv.
BATTLEFORD
PROJECTED
SASKATCHEWAN BRANCH
REDBERRY
THE ELBOW
CLARKS CROSSING
EAR HILLS
EAGLE HILL
NEUTRAL HILLS
The Mossy Wood
EAGLE HILL CR.
BAD HILLS
CAIRN HILL
Gleichen
To CALGARY
Cluny
Crowfoot
Latham
Cassils
Tilley
Kinnvie
Langevin
Bowell
Stair
ROCKY BUTTES
BOW R.
SOUTH SASKATCHEWAN RIVER
THE COTEAU
THE GREAT SAND HILLS
VERMILION HILLS
Thunder Creek
Waldo
Ernfeld
Swift Curr
CANADIAN PACIFIC
Herbert
Morrlach R.
Medicine Hat
Hay Lake
Bridge Cr.
Dunmore
Maple Cr.
BELLY R.
SWIFT CURRENT CR.
OLD WIVES CR.
OLD WIVES L.
CYPRESS HILLS
Ft WALSH
BATTLE R.
Chin Coulee
CYPRESS LAKE
WHITE MUD R.
COTTONWOOD COULEE
WOOD MOUNT
POST
MONTANA
Ft BELKNAP
MILK
PELICAN L.
LONG L.
FISH L.
DEVILS
BIG RIV.
STINKING LAKE
SAND LAKE
Eng. Miss.
SHELL RIV.
SHELL L.
JACK FISH L.
THICKWOOD HILLS
PADDLING
PRINCE ALBE
CARLTON
STOBART
Duck L.
BEARD
INDIAN RES.
Gabriel
Shoal L.
Troat L.
STURGEON


TAB
From Winnipeg to
" Qu'Appelle
" Touchwood
" Humboldt to
" Carlton to B
" Prince Alber
" Humboldt to
" Qu'Appelle t
Unex
BEAVER RIVER
H.B. POST
MONTREAL MTS.
MONTREAL LAKE
SAND HILLS
Troat L.
Shoal L.
N. SWAN L.
BITTERN LAKE
RED DEER L.
LIT. BITTERN
CANDLET L.
BIG STURGEON RIVER
PELICAN L.
LONG L.
FISH L.
DEVIL
BIG RIV.
STINKING LAKE
SAND LAKE
Eng. Miss.
SHELL RIV.
SALT L.
SASKATCHEWAN RIVER
JACK FISH L.
THICKWOOD HILLS
SHELL L.
PADDLING
PRINCE ALBERT
LIT. RED R.
BEAVER CR.
Coles R.
NORTH SASKATCHEWAN
RAPID
FT. ALA CORNE
CARROT RIVER
RED DEER HILL
PANONA CR.
STOBART Duck L.
ST. LAURENT
KINISTEN
CARLTON
BEARD IND. RES.
BIRCH HILLS
WATER HEN LAKE
BATOCHE
Gabriel's Crossing
PASQUIA HILLS
Porcupine R.
Crooked R.
Beaver Cr.
RED DEER RIVER
PORCUPINE MTS.
BATTLEFORD
REDBERRY L.
THE ELBOW
BUFFERS LAKE
DEAD MOOSE LAKE
CLARKS CROSSING
H.B.C. MUD POST
MUD L.
Prairie Butte
Pine Cr.
SASKATCHEWAN BRANCH
HUMBOLDT
PROJECTED
TELEGRAPH LINE
EAGLE HILL
The Mossy Wood
EAGLE HILL CR.
CAIRN HILL
BAD HILLS
LIT. MANITOU L.
Big Quill Lake
Salter Cr.
Gov. Farm
QUILL HILLS
H.B.C.
TOUCHWOOD HILLS
Beaver Hills
LIT. TOUCHWOOD HILLS
FILE HILLS
Hallyard
Little Arm Cr.
LONG LAKE
LAST MTN.
THE COTEAU
THE ELBOW
Loon Creek
FT. QU'APPELLE
Fishing Lakes
QU'APPELLE RIVER
Thunder Creek
VERMILION HILLS
GREAT SAND HILLS
Waldo
Ernfeld
Boharm
REGINA
McLean
Edgeley
Farm
Troy
PHEASANT HILLS
QU'APPELLE R.
FT. ELLICE
Wapella
Swift Cur
CANADIAN PACIFIC R. R.
Herbert
Morlach
Pasqua
Grande Cou.
Pilot Butte
Qu'Appelle
Indian Head
Sintaluta
Wolseley
Grenfell
Broadview
Percival
Moosomin
Fleming
Glen Adelaide
Elkhorn
CURRENT CR.
SWIFT CR.
OLD WIVES CR.
OLD WIVES L.
HURRICANE HILLS
MOOSE MOUNTAIN
Carlyle
Willow Bunch
LE GRAND COTEAU
BIG MUDDY
SOURIS RIVER
Moose Mountain Cr.
Dalesboro
Alameda
WHITE MUD R.
WOOD MT. POST
WOOD MOUNTAINS
BOUNDARY BETWEEN THE UNITED STATES AND CANADA

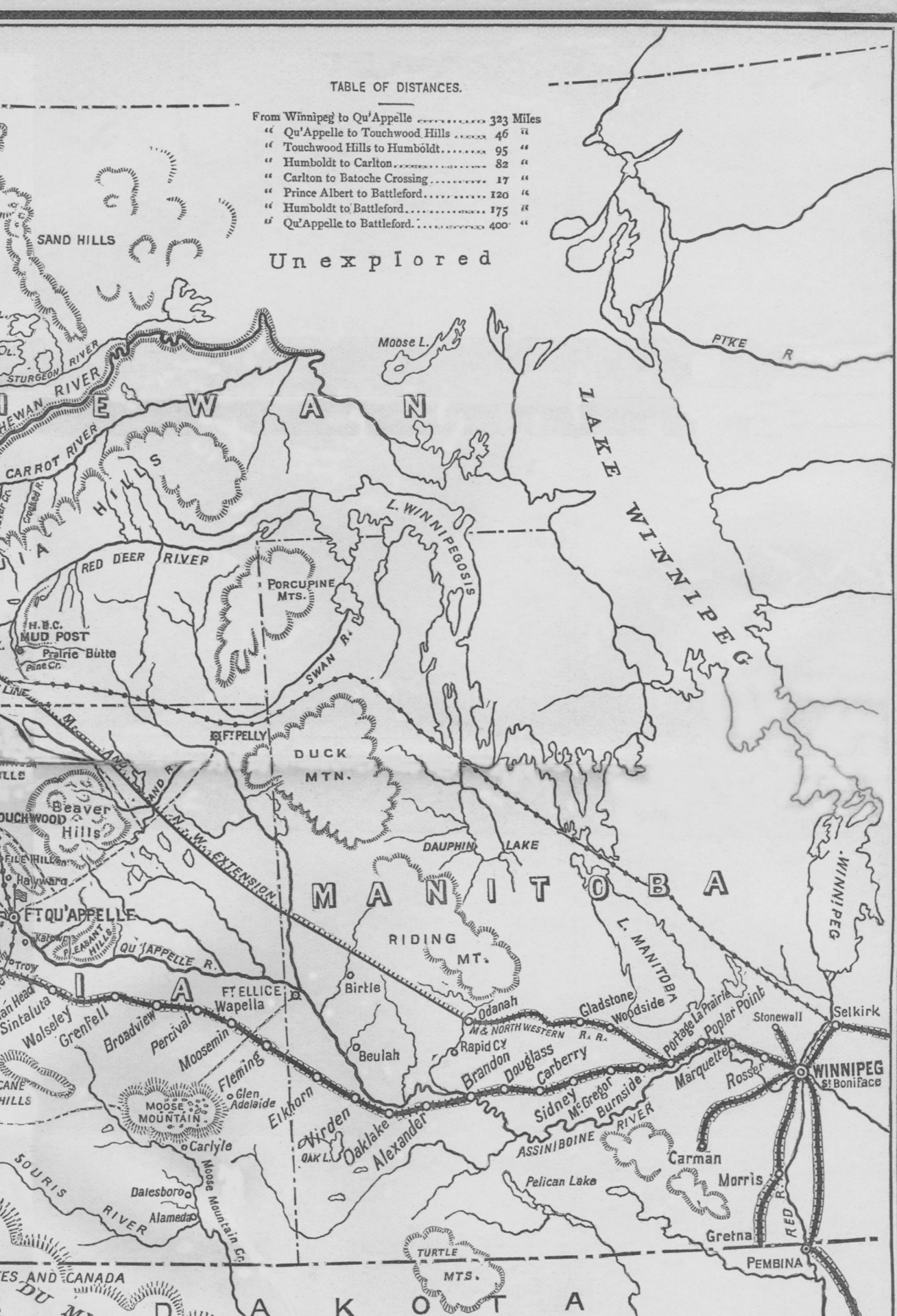
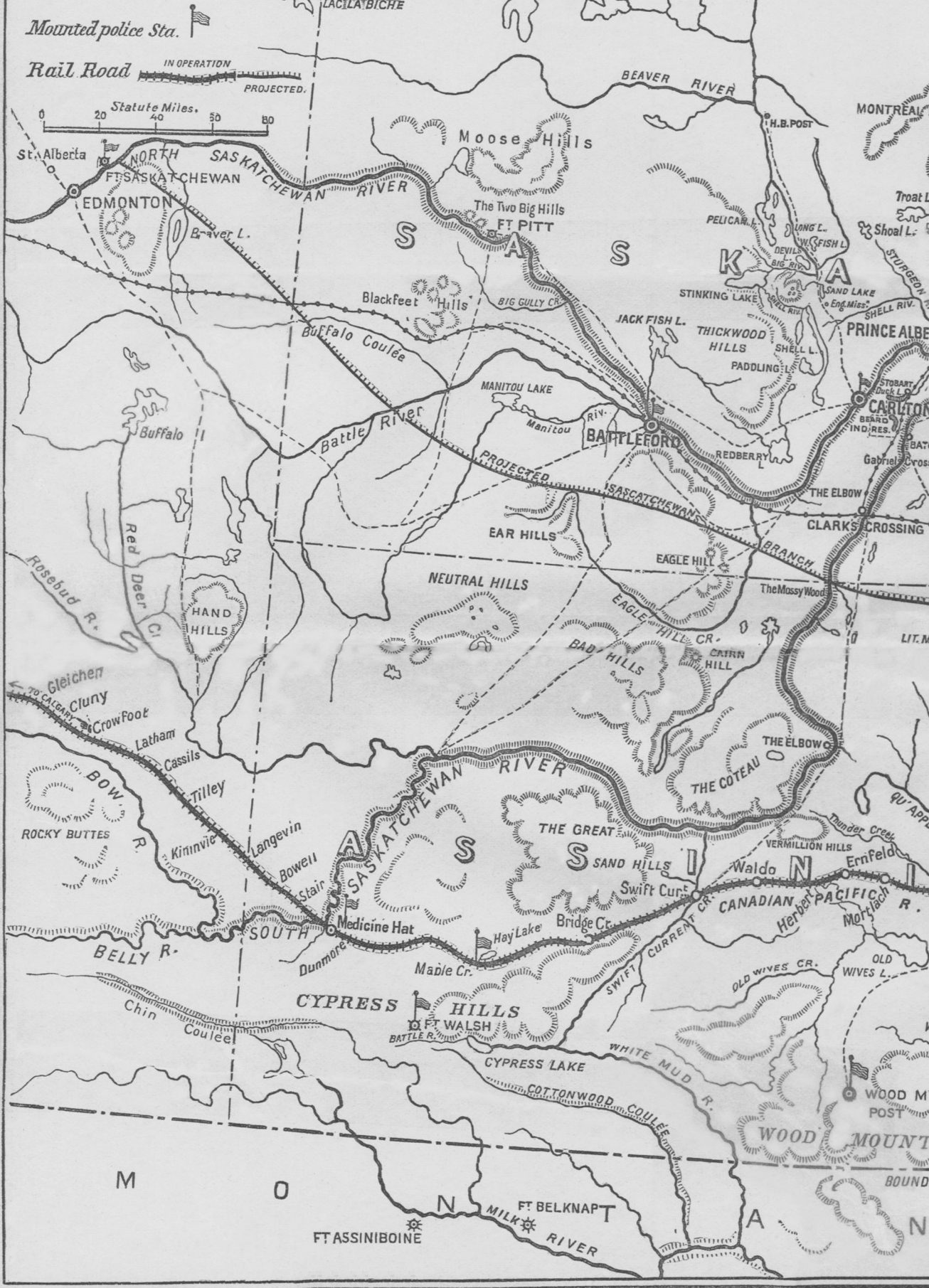


TABLE OF DISTANCES.
From Winnipeg to Qu'Appelle ..... 323 Miles
" Qu'Appelle to Touchwood Hills ..... 46 "
" Touchwood Hills to Humboldt ..... 95 "
" Humboldt to Carlton ..... 82 "
" Carlton to Batoche Crossing ..... 17 "
" Prince Albert to Battleford ..... 120 "
" Humboldt to Battleford ..... 175 "
" Qu'Appelle to Battleford ..... 400 "
Unexplored
SAND HILLS
Moose L.
PIKE R
STURGEON RIVER
SASKATCHEWAN
CARROT RIVER
LAKE WINNIPEG
L. WINNIPEGOSIS
RED DEER RIVER
PORCUPINE MTS.
H.B.C. MUD POST
Prairie Butte
SWAN R.
F! PELLY
DUCK MTN.
Beaver Hills
DAUPHIN LAKE
MANITOBA
WINNIPEG
Hallyard
FT QU'APPELLE
PHEASANT HILLS
QU'APPELLE R.
RIDING MT.
L. MANITOBA
FT ELLICE
Wapella
Birtle
Odanah
Gladstone
Woodside
Portage La Prairie
Poplar Point
Stonewall
Selkirk
Sintaluta
Wolseley
Grenfell
Broadview
Percival
Moosomin
Beulah
Rapid Cy
Brandon
Douglass
Carberry
Marquette
Rosser
WINNIPEG
St Boniface
Fleming
Glen Adelaide
MOOSE MOUNTAIN
Elkhorn
Carlyle
Virden
Oaklake
Alexander
Sidney
McGregor
Burnside
ASSINIBOINE RIVER
Carman
Morris
Pelican Lake
SOURIS RIVER
Moose Mountain Cr.
Dalesboro
Alameda
RED R.
Gretna
TURTLE MTS.
PEMBINA
AND CANADA
DAKOTA



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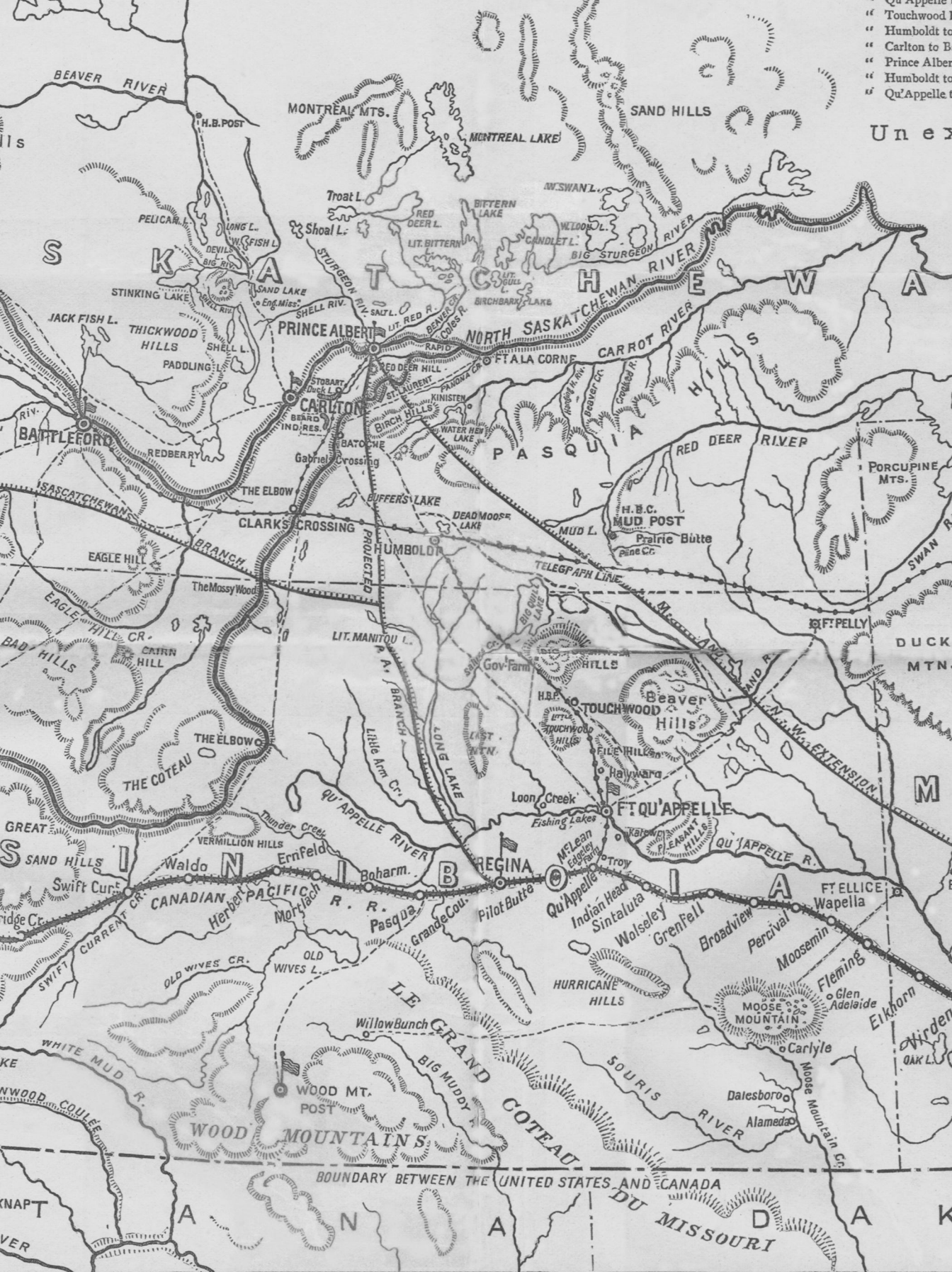
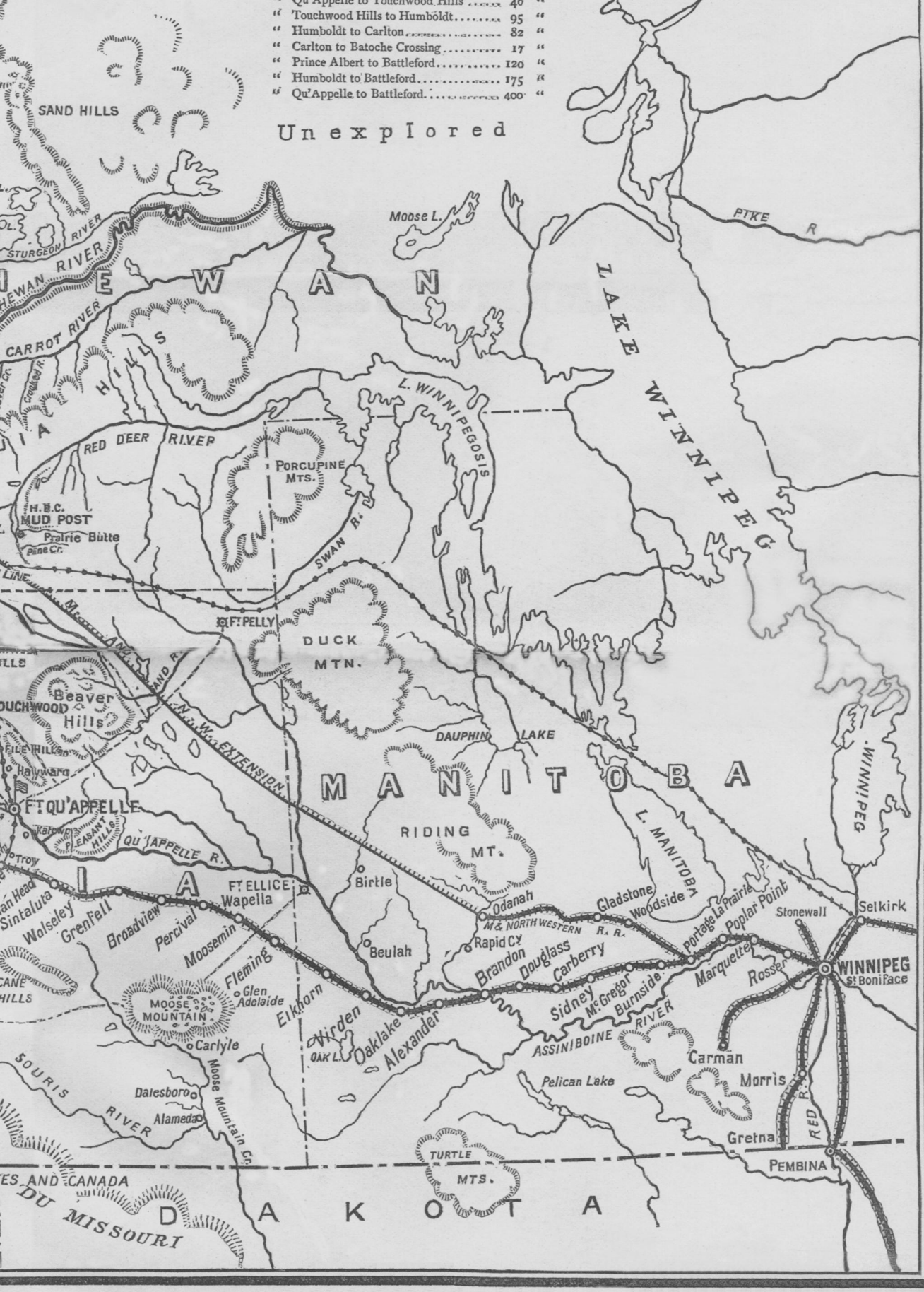
MAP OF THE SASKATCHEWAN REGION, SHOWIN



ASKATCHEWAN REGION, SHOWING POINTS OCCUPIED BY THE REBEL HALF-BREEDS



BY THE REBEL HALF-BREEDS AND INDIANS.

lowest prairie-level, and lies along the base of the eastern Laurentian plateau, has an altitude of about eight hundred feet only. From this level, with minor exceptions, the surface may be regarded as sloping gradually and continuously upward, at a rate of from four to five feet in the mile, to the foot-hills. There the horizontal and unaltered strata of the cretaceous and Laramie formations break against the base of the ancient rocks of the mountains into a series of sharp and nearly parallel flexures, producing a varied and picturesque region, with quite peculiar characters. In the central portion of the plains, the most marked exceptions to their generally even and monotonous contour are found in the tumultuously hilly belt of country known as the Missouri Côteau and in a line of diffuse and indefinite elevations nearly parallel to the Côteau, which includes Turtle Mountain, Moose Mountain, and the File and Touchwood Hills. These hills, or mountains so called, are really tracts of considerable size, with rolling or hilly surface, more or less wooded. The northern extension of the Côteau, where known as the Eagle Hills, near Battleford, also becomes partly wooded.

To any one familiar with the territory lying west of the Missouri, the most remarkable difference of a general character, observable in this northern extension of the same region, is perhaps the extraordinary abundance of small lakes, ponds, or 'sloughs,' which are scattered everywhere over its surface. This peculiarity is evidently in connection with the mantle of glacial drift, which is here universal, and dependent on the irregular deposition of its material. The lakes and ponds, while at times arranged in intercommunicating linear series, are usually distributed without the least apparent regularity, and occupy shallow basins without outlet. Filled by the melting of the snow or rains of the early summer, a great proportion are completely emptied by evaporation before the autumn, while the water remaining in others becomes more or less distinctly saline in many instances. This is more particularly the case with those of the southern and more arid portion of the region. Near the northern margin of the plains, saline lakes are quite exceptional. It is generally on the edge of one of these rush-bordered pools that the traveller makes his evening camp; and, while the abundance of water in one respect facilitates travel in the spring and early summer, the moist condition of the deep alluvial soil at these seasons may prove a more than countervailing disadvantage. The most serious obstacles, however, to be met with in long journeys across the plains, are the various rivers. The Assiniboine, Souris, Qu'Appelle, and other streams of the eastern district, during the breaking-up of the ice, and for some time subsequently, may prove formidable barriers in the absence of bridges or ferries. The North and South Saskatchewan, the Red Deer, Bow, and Belly rivers, all eventually uniting to pour their waters into the northern end of Lake Winnipeg, rise far back in the Rocky Mountains, and, while subject to considerable spring freshets in some seasons, are generally not in full flood till June or July, when the snow is disappearing from the highest summits of the range, and the snow-fields and glaciers about the sources of some of them are melting most rapidly. These streams have trenched valleys across the surface of the plains, which are generally from a hundred to three hundred feet in depth, and a mile to two miles or more in width. All the trails used as regular means of communication make for recognized crossing-places on these rivers, where the approaches are favorable, and where very generally the river may be forded at low water, though ferries of some kind have usually of late years been established for use at other seasons.

As above indicated, almost all the larger river-valleys hold more or less timber; and in the northern part of the region this is not confined to the bottom-land, groves and thickets spreading also into the lateral valleys ('coulées') and broken ground which is very generally to be found in the vicinity of these great river-troughs. Should any serious opposition be offered to the expeditions now on their way to quell the present unfortunate disturbance, it will in all probability be at one or other of the 'crossings' which naturally lend themselves to defence. The rivers, as might be expected from the considerable general inclination of the surface, are usually rapid and shallow, with numerous gravel-bars, and reefs of bowlders, at low water. They are often, moreover, extremely tortuous; and in consequence of these peculiarities, and the considerable portion of each year during which they are ice-bound, they are not extensively utilized as means of communication; and trains of wagons or Red-River carts are still generally employed in travelling, or in the transport of supplies and goods at a distance from the railways. The Hudson-Bay company has, however, for a number of years, used a couple of small stern-wheel steamers between the Grand Rapids, near Lake Winnipeg, and Edmonton, far up on the North Saskatchewan. Two or more steamers

of the same class have quite lately been placed on the South Saskatchewan; and it is proposed to employ these in the present emergency in carrying supplies from Medicine Hat, where this river is crossed by the Canadian Pacific railway, to the vicinity of Prince Albert.

This portion of the interior of the continent was reached in the days of the fur companies, either by the canoe route from Lake Superior, or by ascending the Nelson River from York Factory on Hudson Bay; and it was by the first-mentioned that Sir Garnett Wolseley, with his little force, penetrated to the valley of the Red River in 1870. When St. Paul had become a commercial centre, the Hudson-Bay company began to bring the greater part of its goods from the south; while in later years the police-posts, settlements, and cattle-ranches established in the far west were supplied from Fort Benton, on the Missouri. The Canadian Pacific railway, pushed with unexampled rapidity from Winnipeg across the plains, and completed to the summit of the Rocky Mountains about eighteen months ago, has, however, completely changed the old lines of travel. The time-honored trail from the Red River by Forts Carleton and Pitt to Edmonton — a journey of nearly nine hundred miles, requiring, with loaded carts or wagons, under the most favorable circumstances, nearly forty days — need no longer be followed. The points above mentioned, with other isolated little settlements of more recent date along the North Saskatchewan, are now reached by new trails from the nearest stations to the south on the railway; and a system of telegraph-lines, constructed and operated by the government, unites the more important of them. After leaving the railway, however, the distances to be traversed in the old-fashioned way, before the more remote settlements are reached, are still very considerable. Thus to Carleton and Prince Albert, from Qu'Appelle station, the trail-distances are 228 and 253 miles respectively; from Swift-Current station to Battleford, 202 miles; and from Calgary to Edmonton, 191 miles.

The length of this note does not admit of any detailed description of these and other main roads. It may be remarked, however, that while the trail from Qu'Appelle toward Carleton and Prince Albert, as far as the crossing of the South Saskatchewan, is generally through an open country, groves and belts of aspen are not infrequent in its vicinity. The longest stretch quite without timber is that known as the salt plains, about thirty miles only in width.

The country in the vicinity of Carleton, Prince Albert, and Duck Lake, is rolling, or characterized by low hills with numerous and in some cases extensive groves ('bluffs') of wood. The settlement is of a scattered character, but for the most part confined to the point of land between the two branches of the Saskatchewan, the total population being probably about three thousand.

At the crossing of the South Saskatchewan, by the trail from Swift Current to Battleford, there is a good ferry. This trail, to within about twenty miles of Battleford, is entirely destitute of wood. Battleford was at one time selected as the seat of government of the Northwest territory, but, since the definite location of the railway, has been abandoned in favor of Regina. There are scattered settlements of half-breeds and whites in the neighborhood, and several Cree Indian reserves. The trail from Calgary to Edmonton crosses the Bow, Red Deer, and Battle rivers, and several smaller streams flowing from the foot-hills and mountains. Ferries exist where necessary; and, should these not be destroyed, a rapid advance by this route would be easy. For sixty miles there is no wood on this trail: beyond that point timber is abundant. Edmonton is a somewhat important centre, with a number of little settlements of whites and half-breeds subsidiary to it. George M. Dawson.

THE GLOW-LAMP.

It was stated not long ago that the number of incandescent lamps in this country alone is over one hundred thousand. Such a success as this warrants a glance at the history of the lamp, which is given by A. Gelyi in the *London electrical review.*

While the arc-lamp emits twenty-two hundred candle-light per horse-power, and the glow-lamp gives but a hundred and twenty, it is the possibility of so reducing the light to a minimum that has brought the latter system forward; for, although it is true that the arc-light may be considered capable of a division into lamps of intensities varying from twenty to ten gas-flames, that minimum is in many cases, especially for domestic purposes, a great deal too high, whilst the regulating apparatus is expensive.

But two substances are known which possess such properties as are indispensable for the production of the glow-light; namely, platinum and its alloy with iridium, and, secondly, carbon. The former has the advantage, that, when heated to whiteness, it does not consume away even in the air: but, in a no less important respect, that metal is far behind carbon, for it is by no means capable of sustaining such a degree of heat without fusing; and this is of vital

importance, for the quantity of light emitted by a glowing substance rises in a more rapid proportion than the temperature of that substance.

In 1838 we find Professor Jobard of Brussels saying that "a small strip of carbon in a vacuum, used as a conductor of a current of electricity, would emit an intense, fixed, and durable light." De Changy, a former pupil of Jobard, seems to have taken these words as advice, for he commenced his experiments in that line almost immediately afterwards. About this time an Englishman named Moleyns also made an incandescent lamp by using platinum. De-Changy's experiments failed because the strips of gas-carbon which he used became disintegrated by the current, and, as his globes were not perfectly exhausted or sealed, the carbon gradually consumed away.

About the year 1843, J. W. Starr of Cincinnati entered upon a thorough study of the light, and found in Peabody a munificent promoter of his plans. After helping Starr in every way, Peabody sent him to England to exhibit his invention. Before starting on his voyage, Starr procured himself a companion named King, a shrewd man of business, who immediately had a large chandelier constructed with twenty-six electric glow-lamps, which were to symbolize the states of the Union. The novel spectacle was gazed upon by large crowds; and Faraday, after witnessing the experiments, signified to his American brother electrician his great satisfaction with the result.

Starr died on the return voyage, and King patented the lamp in his own name. This patent was granted on the 4th of November, 1845, and refers to 'a glowing carbon strip in a vacuum.' But with the death of Starr the necessary funds ceased to flow, and in a short time the promising glow-lamp was consigned to oblivion.

A very similar fate befell the inventions of the Englishmen Greener and Staite, who patented, in 1846, another carbon-lamp. Starr formed the necessary vacuum by using a tube thirty-six inches long, filled with mercury; but the generation of electricity was at that time far too expensive, although as regards the clearness of the light, and the durability of the carbon, the lamp was a success.

In 1849 Petrie proposed to patent the use of iridium, but the scarcity of that metal rendered it out of the question. In 1855 DeChangy resumed his studies with renewed zeal, occupying himself with the construction of a lamp in which platinum formed the conductor, and in 1858 patented a current regulator which enabled him to use his lamps for the illumination of mines, submerged for fishing-purposes, and in a nautical telegraph system by which signals were displayed from the mast-heads of vessels. The platinum was submitted to a preparing process of separation, being maintained heated for some time at a moderate degree of redness, and then gradually raised to that degree of heat to which it would be afterwards subjected in the lamp.

At intervals of ten and fifteen years after the inventions of Starr and of DeChangy, the incandescent lamp was revived, with partial success; but it was not until Edison and Swan put their shoulders to the wheel that a perfect and practical lamp was constructed.

In the year 1878 Edison was journeying in the Rocky Mountains, when a companion awakened within him the desire of occupying himself with electric lighting, and on his return to Menlo Park he furnished himself with the necessary apparatus. Like DeChangy, he imagined that it would be easier to use metal than carbon; and, with the abundant funds furnished him by the Edison electric-lighting company, he was enabled to reach almost every substance which his fertile brain might suggest. For instance: it is said that his attention was called to thorium, — a metal particularly difficult to fuse; and, when a mineralogist informed him that there was not a half-ounce of thorium in the whole territory of the United States, Edison called up one of his assistants, and, telling him that in one of the gold-mines of the north-west a quantity of monarite crystals (from which thorium is extracted) had been found, gave him a letter of credit, with instructions to bring him in the shortest possible time a hundred pounds of monarite. In a few weeks Edison had the monarite, and forthwith began his experiments. But thorium also failed; and platinum was again tried, this time with a certain amount of success.

Meanwhile the dynamo-machine and the Sprengel air-pump had been perfected. An Englishman named J. W. Swan now obtained fair results with a filament of charred cardboard, and found that the rapid consumption and consequent breaking of the glowing carbon was an almost insuperable impediment to his success, and he also found that the inner walls of his lamp became darkened by a deposit of some kind. These troubles must have been of a most alarming character. But Swan went on, and obtained the co-operation of a Mr. Stearn, who was considered a great authority as regards perfect vacuum. Evidently he also fully understood that the carbon must be previously heated to whiteness in a good vacuum; and in 1877 he sent to Mr. Stearn a quantity of carbonized cardboard strips, requesting that they be mounted in glass bulbs, subsequently to be exhausted as perfectly as possible. This seems to have been done with rare ability by raising the carbon to a very high degree of heat by means of an electric current, which set free the gases it contained, and afterwards removed them. The ends of the filaments were also made thicker; and when the connections were made good, and the vacuum sufficient, the glass bulb containing the glowing carbon did not blacken, and the consumption of the filament was infinitesimally small. There only remained to make the lamp mechanically perfect; and in 1878 Swan publicly exhibited his glow-lamp, which possessed all the essential characteristics of that in use at present. In the same year Edison discarded metals, and followed in the footsteps of the carbon men. Being forestalled by Swan, Mr. Edison could not use cotton thread in his lamp, and, after a long series of experiments, decided upon the use of filaments made out of a species of bamboo.

A TYPHOON IN SICILY.

In the early morning of the 7th of October, 1884, Etna was seen to be covered with a mantle of clouds, which spread themselves in a north-west direction. At eight o'clock there was a barometric depression throughout the whole western part of Sicily, the mercury falling two millimetres. During the typhoon, which began at about noon, the barometer registered 761.1 millimetres, whereas in the morning at nine o'clock it stood at 761.8 millimetres. The normal average is 762.5 millimetres. The thermometer at nine o'clock was 22.5° C., and during the storm went up slightly. The relative humidity at nine was 0.78,

A VIEW NEAR CATANA AFTER THE TYPHOON.
(From *La Nature.*)

but at noon had risen to 0.88. At eight o'clock the wind was from east-north-east, blowing gently, and at noon was from the south-east. At 12.30, near the Passo Portese, 18 kilometres from Catana, a dark cloud in the form of a spout was seen to form. The rotary movement was opposite that of the hands of a watch, and the spout travelled across the country from west-south-west to east-south-east at the rate of 28 kilometres (17 miles) per hour. It frequently raised itself above the ground for some moments, and then again touched the land to complete its devastation. When near Ognina, it left the land and went to sea, where it died out. The noise produced by the storm has been compared to that caused by many trains of cars passing over an iron bridge at high speed. There were very few flashes of lightning, and only two reports of thunder loud enough to be heard above the storm. Hailstones of great size fell on the northern border of devastation, causing much damage. They were very rough, and some were as large as oranges. One weighed 300 grams. The zone of greatest devastation was about 27 kilometres in length (not including the 5 kilometres at sea), with a breadth of 350 metres. Twenty-seven inhabitants were killed, and five hundred wounded. Many houses were destroyed, trees torn up by their roots and carried away, and in one place a piece of lava weighing 8 kilograms was thrown through a window 10 metres from the ground, while another pierced a house like a bullet.

EFFECTS OF THE TYPHOON IN A CATANA OLIVE-GARDEN.
(From *La Nature.*)

CREEPING OF RAILS.

It has been observed by those having charge of railroad-tracks, that in some places the rails move longitudinally, or 'creep.' On double-tracked lines the rails tend to move in the direction of the traffic; but on single-tracked roads the alternating direction of the trains will naturally neutralize this tendency. Again: on long inclines or grades the track may creep down hill, — a phenomenon which is reasonably attributed to expansion and contraction from successive changes of temperature, the rails slipping in the direction of least resistance; that is, expanding down hill, and contracting up hill. In both cases there is generally little difficulty in arresting the movement by driving spikes into the ties through the notches provided for this purpose, either in the rail-flanges at or near their ends, or in the angle splice-bars so commonly used at joints. The rail often exerts considerable force against these spikes or bolts, and has been known, in some instances, to partially cut or shear them off. The thrust is resisted by the ballast in which the ties are bedded.

A curious instance of rail-creeping, which it is difficult to explain, was given in the *Railroad gazette*, Dec. 5, 1884, where it is stated, that on a piece of single track on the New-York and New-England railroad near Hartford, Conn., a part of which was level, and the rest on a grade of twenty feet per mile, with an equal number of trains each way, one rail moved down hill five feet and one inch in the course of a year, and the other moved eighteen inches in the reverse direction. It has been suggested that the spikes in the two ends of the ties or sleepers may not have been properly alternated, thus allowing the ties to turn horizontally from the correct position at right angles to the rails.

That the elastic yielding of the ballast under the passing loads, and the slight rocking of the ties, absorb or resist the creeping force, would appear from the fact that the tendency to creep is most pronounced where the supports under the rails are held rigidly, as in bridges. On the Harrisburg bridge, over the Susquehanna, the Pennsylvania company encountered this difficulty, but arrested the movement by spikes through the angle-splices at joints. On the St. Louis arched bridge, and its east approach, there is found a most remarkable example of creeping rails. Prof. J. B. Johnson, in a paper read before the Engineers' club of St. Louis,[1] discusses this case at length, and offers an explanation.

The bridge proper is 1,600 feet long; the east approach, a series of short girders on iron columns, is 2,500 feet long, with a grade rising towards the bridge of eighty feet per mile; both are double-tracked. As it was thought by those in charge of the bridge that fastenings at frequent intervals, to resist the movement, would bring too great a strain upon the structure, the attempt was made to restrain the rails by holding them firmly at isolated points some distance apart, with the result that spikes, bolts, and splice-bars were sheared off or torn apart. After the failure of attempts to arrest the creeping, the track was cut at the two abutments and at the east end of the east approach. The time of eight men (five by day, and three by night) is stated to be largely occupied in changing rails at these points. Where the openings are enlarging, short pieces of rail are taken out, and longer ones put in their place: where the openings are closing up, the process is reversed. Each operation is performed many times a day, and a careful record is kept, from which the following facts were obtained: the north track, when carrying an annual westward traffic of about 5,283,000 tons, moved west on the approach and up-grade 401 feet in a year, and on the bridge moved 264 feet; the south track, under an eastward traffic of 4,807,000 tons, crept east 414 feet on the approach, and 240 feet on the bridge, in the same time. The movement each way on the bridge was proportional to the tonnage; and the difference on the approach was doubtless due to the grade, as the changes of temperature would produce a slipping down hill, as previously stated.

Professor Johnson cites some explanations of this case that have been given: viz., the stopping of trains on the bridge; the deflection of the bridge itself by the weight of the train; the distortion of the arch, as a train enters a span, by its curve becoming less convex on the loaded portion, and more convex on the unloaded side, with a reversal of the distortion as the train passes over and off the span, the arch thus slipping under the rails; and, finally, the elastic rolling-out and recovery of the rails under successive wheels, as we may imagine a strip of rubber to move as a roller is passed over it. He does not think, however, that these causes are sufficient to account for so great a movement, and, in explaining his theory, offers a preliminary illustration. Suppose a span of a bridge to have supports exactly alike, such as sliding surfaces, at the ends of the bottom chord, and a train to enter upon it. The bottom chord is stretched by the action of the load, and, as the end where the engine enters is held fast by the added weight, the other end must slip on its support in the direction of the train movement. As the cars pass off at this latter end, and hold it fast, the lower chord shortens, and recovers itself at the first bearing by slipping towards the train. Thus the bridge creeps in the direction of the moving train. If the points of support were under the upper chord, the direction of this creeping would be reversed. When rollers are placed under one end, and the other is anchored fast, the slip and recovery take place on the rollers, and no creeping results.

He notes that between the trucks of every car the rail springs up from the support an appreciable distance, by reason of the elasticity of its bearings, and that, when pressed down by the passage of the rear truck, any marked point on it has advanced a small distance. A wave-motion of the rail may be perceived in advance of every wheel, and an increment of forward movement every time a wheel passes. The more cars, the more movement for any train. The rail moves across the bridge by reason of the extension under flexure of the flange on which it rests. In proof of his position, he showed, by a model over which a loaded wheel was rolled, that a rail supported by the bottom flange will creep forwards, and that the same rail, when supported by its head, will creep backwards; and hence he argues that some point of support between the head and the bottom flange may be found, for which the tendency to creep shall be zero.

[1] Journal of the Association of engineering societies, November, 1884.

THE PATRIARCHAL THEORY.

IN 1861, Sir Henry Maine's work on 'Ancient law' was published. In that work he clearly set forth the importance of 'legal fictions' in the development of institutions. In this respect, his work will remain as a permanent contribution to the science of society. In the same treatise he made an exposition of the patriarchal theory of the origin of society, which had long been held by a class of writers in Europe. In his introduction he says, —

"This evidence establishes that view of the race which is known as the patriarchal theory. This theory is based on the scriptural history of the Hebrew patriarchs. All known societies were originally organized on this model. The eldest male parent is absolutely supreme in his household. His dominion extends to life and death, and is as unqualified over his children

The patriarchal theory. Based on the papers of the late John Ferguson McLennan. Edited and completed by DONALD MCLENNAN. London, *Macmillan*, 1885. 16+365 p. 8°.

as over his slaves. The flocks and herds of the children are the flocks and herds of the father. These he holds in a representative rather than in a proprietary character.''

Subsequently 'Village-communities in the east and west,' 'Lectures on the early history of institutions,' and 'Dissertations on early law and custom,' were published, in which Maine still advocated the patriarchal theory. Arguments for this supposed origin of society were derived from the history of the Romans, Greeks, Hindoos, Celts, Teutons, Slavonians, and Hebrews.

In 1868 the Smithsonian institution published Morgan's great work on 'Systems of consanguinity and affinity of the human family;' and in 1877 his work on 'Ancient society' appeared. In these, and in miscellaneous articles published in the reviews, Morgan clearly and fully established the existence of more primitive forms of social organization than those exhibited in the Scriptures and early Roman history. Thus the patriarchal theory fell to the ground. Morgan's investigations extended far and wide among the lower tribes of mankind, and his work altogether constituted a masterpiece of inductive research.

But we now know that Morgan's work had one blemish. Seeing that the growth of family institutions, which constitute a large part of primitive sociology, was in the main toward a higher state of society as measured by the standard of civilized ethics, he accredited savage peoples with modern opinions relating to physiology, and with a high degree of moral purity, and held that the growth of institutions was due to a conscious effort at reform. While, therefore, Morgan's theory of the structure of primitive society was established on abundant facts, his theory of the origin of this structure and the cause of its development was unsound. Thus it occurred that a theory of the structure of society resting upon an inductive basis was to some extent discredited because of *a priori* theories of social and moral reform. Inductive conclusions suffered by reason of their association with deductive errors. For these reasons certain scholars in Europe, and especially in England, have to some extent ignored Morgan, and have gone on to re-affirm and elaborate the patriarchal theory. Chief among these is Sir Henry Maine.

J. F. McLennan, the author of 'Primitive marriage,' and other works on tribal society, collected a great body of facts relating to marriage by capture, and the interesting formalities which supervene upon that institution, and from them deduced the theory of exogamy and endogamy, by which he classified the tribes of mankind into exogamous and endogamous, and thus failed to discover that exogamy and endogamy are correlative parts of the same institution. McLennan was evidently dealing with facts more primitive than those with which Maine was dealing, and, soon discovering the errors into which Sir Henry had fallen in his patriarchal theory, he finally commenced the preparation of a critical treatise on that subject, probably for the purpose of clearing the ground for the more elaborate treatment of his theory of marriage and concomitant theories of tribal kinship. He died before his work was completed. His brother, Donald McLennan, has taken up the subject, and edited the papers, adding new material. The book which we now have before us is the result, and is a very fine piece of destructive criticism. The entire field occupied by Sir Henry Maine is reviewed; and the facts from Aryan and Semitic history are carefully examined, and shown to be quite contradictory of Maine's theory. He shows, further, that the particular form of patriarchy discovered among the Romans, and which Maine claimed to have been the universal form, was exceptional, and that the Roman tribes presented the sole instance. To American anthropologists this work may seem one of supererogation; but it will serve a good purpose by clearing the ground of false theories which have had deep root, and have been continually springing up to choke the growth of sounder doctrines.

In this new book by the McLennan brothers, the destructive part is much more satisfactory than the constructive: in fact, the critical portion is somewhat marred by erroneous theories relating to primitive marriage, and by some strange blunders relating to kinship, — blunders common to many writers on sociology.

It seems probable that a form of social organization based upon communal marriage was primordial; but, be that as it may, it must here be neglected. It has been established that a very early form of society was based upon kinship, and that kinship was used to organize peoples into groups of different orders. In the very simplest form, there is always a larger group including two or more smaller groups. In this grouping, kinship of one kind is used to combine the individuals of a smaller group into a minor body politic, and kinship of another kind to combine the groups into the larger body politic. Thus the group in its various orders depends upon the recognition of different kinds of kinship. To make this plain, it becomes necessary to define

the kinds of kinship recognized in primitive society. First, then, kinship by consanguinity and kinship by affinity are clearly distinguished. Then kinship by consanguinity, or 'cognation,' as designated in Roman law, is divided into parts. The consanguineal kindred of any given person may constitute a large body. There may be selected from this body all of those persons whose kinship may be traced exclusively through males. Such kinship was called by the Romans 'agnation,' and the body of included kindred, 'agnates.' From the same body of cognates there may be selected all those who can trace their kinship exclusively through females. Let such kinship be termed 'enation,' and the body thus constituted, 'enates.' The agnates and enates together constitute but a part of the whole body of consanguinei or cognates. In all tribal society, either the agnates or the enates are clearly distinguished from the other cognates, and organized into a body politic, usually called the clan or gens.

Maine holds in that primitive society agnation was the only kinship recognized, and that enation is an accidental and infrequent derivative; that the true course of kinship development is from agnation to cognation. McLennan holds that in primitive society enation only was known; that agnation is an accidental and infrequent derivative; and that the true course of evolution is from enation to cognation. The fact is, that cognation, including enation and agnation, is primitive; that is, that no society has yet been discovered among the savage tribes still living on the globe, or in recorded history, that has not recognized cognation in its different branches; and in all cases different kinds of kinship have been used for different organizing purposes.

In the simplest form above mentioned, where the group constituting a tribal state is organized into sub-groups, sometimes the higher group is bound together by affinity and general cognation, while the smaller group has a kinship bond of enation. And, again, sometimes the higher group is bound together by affinity and general cognation, while the smaller group is organized on agnation. In either case, the tribal bond is affinity with cognation; and in like manner the clan bond is either agnation or enation. The evidence that cognation has been recognized in all tribal peoples, is complete. Not a single tribe has yet been found to ignore it in its social organization; and, in every language that has been investigated, kinship terms for it are discovered. The real question, therefore, is not whether agnation or enation is the more primitive, but whether agnatic kinship or enatic kinship was the tie which bound together the members of a clan or smaller group in the tribal organization. Sir Henry Maine and the McLennan brothers alike have failed to discover this, one of the most patent facts concerning primitive institutions; and this failure has led both parties into the most radical errors.

There is another institutional principle which seems to be primordial; at any rate, it is everywhere woven into primitive custom-law. This principle will here be called 'elder-rule.' It would seem that primitive men in the savage state, groping for some means to prevent controversy and secure peace, hit upon the very obvious expedient of giving authority to the elder; so that, in all the relations of life, superior age should confer authority.

There are thus two primordial principles in early law: the first is that kinship by affinity and consanguinity is the bond of society; and the second is that authority inheres in the elder. These two principles have been worked out in many and diverse ways, and about them have gathered many legal fictions; but they were primordial, and have been universal down the whole course of history, including the highest civilization; so that even now affinity and consanguinity, both agnatic and enatic, together with elder-rule, still continue, — the one as the bond of the civilized family, and the other as its rule of authority. But the history of the application of these principles is long and varied.

The Roman patriarchate was defined by agnation; and the group was a body whose kinship was reckoned only through males, and over whom the patriarch, who was the highest male ascendant, was the ruler. This ruler had despotic power. He owned his wife, and by legal fiction reckoned her as the elder sister of his daughters. He also owned his sons, and his sons' wives, and their children, and was the owner or custodian of all the property belonging to the group. This is *patria potestas*. The patriarchy, therefore, is a despotic form of elder-rule exercised by the eldest ascendant over a group of agnatic descendants. On the death of the patriarch, the group was dismembered into as many parts as there were sons with families. The patriarchal group, therefore, was dissolved and re-organized with every passing generation.

There is another form of elder-rule, which I shall denominate 'presbiarchy,' in which the ruler is the oldest man of the kinship group,

whether that group be agnatic, enatic, or cognatic. Such a group does not necessarily dissolve on the death of the ruler, for the next younger man who is the oldest of the group takes his place. The group, therefore, is comparatively permanent, and there is no inherent necessity for its dissolution. It may remain as long as there is a living man to act as ruler. Presbiarchy has widely prevailed: in fact, it seems to be primordial.

The patriarchy, with its *patria potestas*, as far as we now know, was confined to the Roman tribes: but the patriarchy without absolutism has been much more widely distributed, and it has probably been associated also to a greater or less extent with presbiarchy, real or fictitious; so that the latter has frequently been divided into patriarchies, they being subordinate groups.

Maine and the McLennan brothers seem not to recognize presbiarchy; and Maine, wherever he discovered evidences of it, and also where he discovered evidences of any other form of elder-rule, presented them as proof of the existence of the patriarchy. Had the McLennans recognized elder-rule, they could have made their criticism of Maine much more effective. As it is, they have successfully attacked Maine's theory by showing that *patria potestas* has not been widely spread; in fact, that there is no evidence of its existence, except among the Romans.

Maine also bases his theory of the primordial and universal patriarchy upon his theory of agnation; and, wherever he discovers a recognition of agnation, he holds that it is evidence of the patriarchy with *patria potestas*. The McLennans show that agnation is not the only kind of kinship recognized in tribal society, by arraying much evidence of the recognition of enation; but they themselves fall into the antipodal error of supposing that enation was the only kind of kinship recognized.

Altogether the patriarchal theory of Maine has been successfully overthrown in the work before us, by a re-examination of the very facts adduced in its support; and we owe a debt of gratitude to the authors for the thorough way in which they have accomplished their task. If, now, Sir Henry Maine will on his part as completely overthrow the McLennan theory of exogamy and endogamy, and its concomitant polyandry, the ground will be well cleared for the development of a sound system of sociology upon the inductive basis established by Morgan.

Connected with this theory of the patriarchy is Spencer's theory of ancestor-worship, by which he accounts for the genesis of theism, — a theory which ignores all the facts of savage philosophy, finds an origin for opinions midway in the history of culture, and accounts for later opinions as following in the course of normal development, and for early opinions as degeneracies. With the final overthrow of the patriarchal theory, the ancestral worship theory has its weak foundation entirely removed. A piece of good destructive criticism here would be opportune.

Spencer's ghost theory of the origin of a dual existence has long been overthrown by Tylor's grand induction denominated 'Animism.' A good piece of destructive criticism on this point also would be timely.

J. W. Powell.

LESQUEREUX'S CRETACEOUS AND TERTIARY FLORA.

This work is the third, and will undoubtedly be the last, of the series of final reports contributed by this author to the publications of the U. S. geological survey of the territories in charge of Dr. Hayden, and which together constitute a truly great and enduring monument to the fame of the now venerable paleobotanist. The first of these volumes appeared in 1874, and was devoted to the flora of the Dakota group, the only cretaceous flora then known in the west. The second, a larger work, came out in 1878, and was called the 'Tertiary flora;' but more than half of it was taken up with species of the Laramie group, by many regarded as cretaceous. The present volume is in the nature of a review of the whole field covered by the two preceding, bringing the matter down to date, and embraces some Pacific-slope miocene localities in addition.

The first hundred and twenty pages and eighteen plates are devoted to a revision of the flora of the Dakota group, and the description and illustration of thirty-five new species from that formation. At the close of this division of the work, the author introduces an exhaustive table of distribution, extending it to embrace the entire Cenomanian formation, to which he assigns the Dakota group, as well as the middle cretaceous of Greenland. He divides the Cenomanian of Europe into three groups of localities: viz., 1, Moletein, Quedlinburg; 2, Quadersandstone, Harz, Bohemia;

Contributions to the fossil flora of the western territories. Part iii. The cretaceous and tertiary floras. By Leo Lesquereux. Report of the U. S. geological survey of the territories. F. V. Hayden, U. S. geologist in charge. Vol. viii. Washington, *Government*, 1884. 12 +283 p., 59 pl. 4°.

3, Niederschoena, Saxony, Hungary. Some of these districts are exceedingly vague; 'Quadersandstone,' for example. Niederschoena is in Saxony; and Quedlinburg is in the Harz district, at the same horizon as Blankenburg, which is not Cenomanian at all, but Senonian. From all these sources he enumerates 442 species, — a number which is still too small. The Dakota group alone furnishes 195 species.

The second division of the work relates to the Laramie group, but does not review its flora. Some dozen additions to it, made by Mr. Lakes at Golden, Col., are described, six of which are new species. Mr. Lesquereux here discusses again the geological position of this group, and, while still insisting upon its eocene character, admits that its flora resembles that of the travertines of Sézanne in the Paris basin, but which are known to lie considerably lower than the coarse limestone and lignites that prevail in that district. In his table of distribution he only enumerates 207 species; but the reason for this paucity is his failure to recognize as Laramie the plants described from the Fort-Union group, — the upper Missouri and lower Yellowstone region, and the Bad lands of Dakota.

The third division of the work consists of an exhaustive survey of the flora of the Green-River group; and, as this had not previously been done, it forms altogether the most valuable part of the treatise. Since the appearance of the 'Tertiary flora,' a large amount of material from this formation had accumulated in the author's hands, out of which he obtained no less than ninety new species. The most fertile source of this material was the small locality in South Park, Col., known as Florissant, from which, in a light volcanic ash, also containing insect-remains, an immense number of beautifully preserved specimens of fossil plants have been derived. The other principal localities grouped under the general designation of 'Green-River group,' are those of Green-River Station and Alkali-Stage Station, Wyoming; Elko Station, Nev.; and a place reported as in 'Randolph county.' As to this last, as there appears to be no Randolph county in any western territory, it is probable that Randolph courthouse, Rich county, Utah, is meant, which is the same as is otherwise known as Bell's Fish-Cliff, where fine specimens of palm-leaves and other fossil plants are found. The locality called Barrel's Springs is also here referred to the Green-River group, although it appears in the preceding table as belonging to the Laramie group. This is confusing, to say the least.

We have not space to show how the floras of these several localities are correlated by the author; but the occurrence of identical and wholly characteristic species in several of them seems to establish their geological synchrony with considerable certainty. This formation is now commonly regarded as eocene; but Mr. Lesquereux, led, as in the case of the Laramie, by the affinities of the flora with that of Europe, insists upon placing it somewhat higher, and calls it 'oligocene.'

The remainder of the work is devoted to what is called the 'miocene flora.' So far as the localities on the Pacific slope (Chalk Bluffs and Corral Hollow, Cal.; John Day valley, Ore.; and Alaska) are concerned, this reference is doubtless correct; but the large collections from the 'Bad lands of Dakota' belong almost without question to the Fort-Union group, and should have been referred to the Laramie, with which the invertebrate fauna forces us to correlate that group. It is true that this flora has a marked miocene aspect when compared with those of European strata, and that several species seem to have persisted from that period to the present (e.g., Corylus Americana, Onoclea sensibilis); but the entire Laramie flora is also strongly miocene, and at least one species (Ginkgo biloba, L.) of the living flora has come down to us seemingly unchanged from the typical Laramie of Point of Rocks, Wyoming.

Geological considerations aside, this volume is one of the most important that have lately appeared upon the paleontology of western America, and, should it prove his last work, would fittingly crown the long and faithful labors of its justly celebrated author.

ANTHONY AND BRACKETT'S PHYSICS.

FOR many years the English have borrowed or stolen their text-books of elementary physics from the French, and Americans have borrowed or stolen from the English. About a year ago, Daniell produced a distinctly English, or rather distinctly Scotch, book of this order. Now Professors Anthony and Brackett have undertaken to remove America's reproach. Their book is to consist of two parts, of which part i., 'Mechanics and heat,' has already appeared. It is a small volume, and in other respects shows a disregard of old traditions. It has numerous diagrams, but hardly a *picture*.

Elementary text-book of physics. Part i. Mechanics and heat. By Prof. W. A. ANTHONY and Prof. C. F. BRACKETT. New York, *Wiley*, 1884. 9 + 246 p. 12°.

It gives almost at the start a short treatment, much shorter than Daniell's, of simple harmonic motions; and it devotes several pages to the idea and theorems of potential. The subject of air-pumps, and with it much that is wont to make the student miserable, is dismissed after a treatment of four pages. In the chapters devoted to heat we miss the familiar names of Dulong and Petit, and the other pre-Regnault investigators of the phenomena of expansion. The steam-engine occupies one page, without an illustration. Carnot's cycle, with related matters, fills ten pages.

The book is written with great care. Its language is clear and judicious. There are, of course, slight inaccuracies. For instance: the first sentence of article 26 reads as if a point could be located by means of its distance from any one plane. Again: on p. 209 we find it stated as having been demonstrated experimentally by Joule, that, "when a gas expands without performing external work, it is not cooled;" the later experiment of Joule and Thomson, which led to a different conclusion, not being mentioned.

From beginning to end, this volume of Anthony and Brackett grapples with difficult principles boldly and in good faith, as if the authors expected their whole book to be read and mastered. Trigonometry is freely used, and occasionally something that borders on the calculus. The long experience of the authors as teachers encourages the hope that they have not over-estimated the capacity of college classes; but, excellent as is the matter and the manner of the book, one fears that the ordinary student will find portions of it formidable.

Perhaps it should not be otherwise. Certainly the extraordinary student, who craves strong meat, will find it here, and of the best. So small a book cannot teach all there is to learn: it is not intended to do so. It does not show the whole of physics, but it shows physics as a whole.

NOTES AND NEWS.

DURING the opposition of Neptune just passed, Professor Pickering continued the observation of the planet's magnitude with the meridian photometer of the Harvard-college observatory in the same method as previously employed. Nine series of observations extend from Dec. 16, 1884, to Jan. 21, 1885, the final result from which, when corrected for atmospheric absorption, instrumental error, and reduction to mean opposition, becomes 7.63. The residual difference for only one series is as great as two-tenths of a magnitude. The corresponding results for two previous seasons are 7.71 and 7.77. Contrary to the experience of Mr. Maxwell Hall of Jamaica, who found evidence for a rotation-period of Neptune in small variations of the planet's light according to his own observations, Professor Pickering regards it as improbable that there is any variation in the light of Neptune of a strictly periodic character, and further calls attention to the influence, much neglected by observers, upon the observed brightness of objects when seen east and west of the meridian on the same night. This has to be taken account of in the observations of maxima and minima of many variable stars, and may to some extent account for the variations of Neptune's light detected by Mr. Hall.

— Prof. Charles E. Bessey writes to the *American naturalist* that fifteen years ago there were no dandelions in the Ames flora (in central Iowa): now they are very abundant, and have been for half a dozen years. Then there were no mulleins: now there are a few. Then the low and evil-smelling Dysodia chrysanthemoides grew by the roadside in great abundance: now it is scarcely to be found, and is replaced by the introduced 'dog-fennel' (Anthemis cotula). Then the small fleabane (Erigeron divaricatum) abounded on dry soils: now it is rapidly disappearing. Then no squirrel-tail grass (Hordeum jubatum) grew in the flora: now it is very abundant, and has been for ten years. Then there was no burr-grass in the flora: now it is frequently found, and appears to be rapidly increasing. Both of these grasses have apparently come in from the west and north-west. Fifteen years ago the low amaranth (Amarantus blitoides) was rather rarely found: now it is abundant, and has migrated fully a hundred and fifty miles north-eastward. This plant has certainly come into the Ames flora from the south-west within the last twenty years. Old settlers say that there have been notable migrations of plants within the past twenty or thirty years. The buffalo grasses of various kinds were formerly abundant in the eastern part of the state: now they have retreated a hundred to a hundred and fifty miles, and have been followed up by the blue-stems (Andropogon and Chrysopogon). The blue-stems now grow in great luxuriance all over great tracts of the plains of eastern Nebraska, where twenty years ago the ground was practically bare, being but thinly covered by buffalo grasses. In Dakota it is the same: the blue-stems are marching across the plains, and turning what were once but little better than deserts into grassy prairies.

— A principle that may generally be wisely adhered to by reviewers is that notices of books appearing in numbers should not be based on the first number issued; but this can be safely departed from in announcing the preparation of a new (fourth) edition of Meyer's 'Konversations lexikon,' of which the first part appears with imprint of 1885. Sixty-four pages carry it to 'Absteigung.' Abyssinia is allowed six and a half pages, which include liberal reference to sources of information, an essential in all good encyclopaedias. Among the illustrations there are

chromolithographed plates of African tribes and of the Alps, both finely executed. The work is to run through two hundred and fifty-six weekly numbers.

— Mr. A. Ainslie Common, well known as the maker of a powerful reflecting-telescope at Ealing, Eng., has been experimenting in the application of photography to the production of stellar maps. A small lens of four inches and a half diameter has been found sufficient to show stars of the ninth magnitude; and one of the photographs of the region about *Altair* (α Aquilae) was found to contain eighteen hundred separate stars which had been identified.

— Messrs. Hachette have just published vol. x. of the 'Nouvelle géographie universelle' of Elisée Reclus, which shows the same amount of care and energy as its predecessors. The maps are as numerous as ever, and the illustrations, nearly all taken from photographs, are excellent. This volume deals with the basin of the Nile, and thus embraces regions in which the public are just now specially interested. Mr. Reclus furnishes full accounts of the physical geography of the country, and of its inhabitants, but very wisely abstains from discussing the political events of the day. The information has been well brought down to date, documents published as recently as November, 1884, having been consulted.

THE CREVASSE ON THE ROAD FROM LOJA TO ALHAMA, SPAIN. (From *L'Astronomie.*)

— The Natal *Mercantile advertiser* gives a lengthy account of the expedition of Dr. Aurel Schulz in the interior. One strange tribe discovered by the party on the Kabengo River, was the Makuba tribe. They are strongly aquatic, taking to the water like fish, splendid fishermen, well built, strapping fellows of Zulu type, expert canoeists, and the corn-growers of the country-side, and, in addition to all this, imbued with a horror of shedding human blood, so much so that a man of the outside blood-shedding tribes is always 'open to back himself to give battle to fifty Makubas any day.' Another interesting matter is the account of the chief Kama, who rules at Soshong, the capital of the northern Bechuana. He governs his people well: his great wish is to have them well armed with guns, and provided with ammunition. Alcohol in any shape is not allowed in his dominions. No kafir beer is brewed. Any white trader selling liquor is fined up to a hundred pounds; any subject brewing is expelled from the country. All, from the chief downward, are stanch teetotalers. Kama claims dominions up to the Tyobe River, though those portions do not pay tribute. He gives as much as a hundred and eighty pounds for a horse, and is an expert rider himself. His history is romantic, and will be read with interest when it appears.

— Prof. Silvanus P. Thompson, formerly professor of experimental physics at University college, Bristol, has been made director of the Finsbury technical college of London.

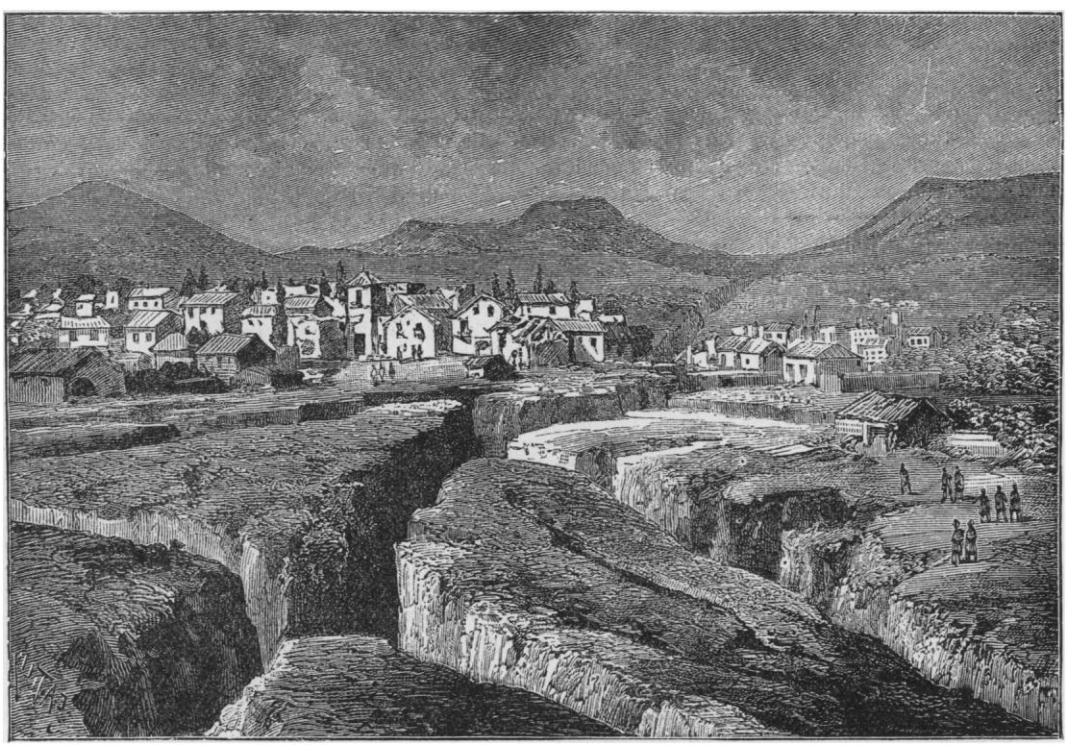
— The Norwegian brig Coulant reports, that on March 21, in latitude 13° 22′ north, longitude 45° 30′ west, the ship was going nine knots under full sail, when she struck something, apparently a sand-bank, and continued striking for half a minute. The vessel's speed was reduced to about five knots. The captain had no time to get a lead over, and could sea nothing over the sides. At the time a heavy sea was running. It has been suggested that this might have been a submarine earthquake.

— The *Japan gazette* publishes a brief statement from Mr. Gowland, technical adviser to the Imperial mint at Osaka, on his observations during a recent journey through a part of Korea. He spent ten days at Söul, the capital, and twenty days on the overland route between that place and the port of Fasan. He did not observe any indication of mineral wealth: there were no signs of mines, and nothing beyond doubtful indications of mineral veins in one or two places. There are no mountains exceeding about four thousand feet in highest elevation, and no characteristic volcanic cones. The central range was crossed by a pass twenty-three hundred feet above the sea-level. The forests were of no great extent; but very extensive tracts of cultivated ground, evidently yielding a large surplus production of rice, barley, and beans, were noticeable throughout. There was a marked absence of any manufacturing industry, or of indications that any thing beyond food-products received attention. The traffic on the roads was very limited, — no signs of wealth, no money, and no foreign trade.

— Views of the devastation caused by the recent Spanish earthquakes still afford material for the foreign illustrated papers. The cuts here copied are taken from *La Nature* and *L'Astronomie* of recent dates; and the first one, at least, gives evidence of being drawn after a photograph, or from a careful sketch. The fracture here represented in part is described as being about a mile and a half long, and of considerable but undetermined depth. A church has sunk in it, leaving only the top of its tower above ground. The formation of the crevasses was violent, accompanied by an explosive noise; and, where they traversed villages, escape from ingulfment was by no means easy. A muleteer lost one of his mules in a fracture, and the artists of *L'Astronomie* have not hesitated to commemorate this sad occurrence by a

view that must be essentially imaginary, — a method of illustration that is unfortunately too common in works on geography.

— As the result of a series of observations made at seventeen forest meteorological stations in Prussia, Professor Müttrich has arrived at certain definite conclusions respecting the influence of the forest on temperature, which may be stated as follows: 1. The forest exercised a positive influence on the temperature of the air; 2. The daily variations of temperature were lessened by the forest, and in summer more than in winter; 3. The influence of the leafy forest was in summer greater than that of the pine-forest, while in winter the tempering influence of the pine-forest preponderated over that of the disfoliaged forest. An attempt to determine the influence of the forest on the mean annual temperature led to no sure results.



THE CREVASSE NEAR GUÉVEJAR, OPENED BY THE EARTHQUAKES IN SPAIN LAST DECEMBER. (From *La Nature*.)

— By the present method of extracting gutta-percha, practised by the native Malayans, the tree is cut down, and the bark slit at various intervals, and, after the gum which exudes is removed, the tree is allowed to rot in the jungles. From a paper by Mr. J. L. Wray, jun., curator of the Perak museum, published in the Journal of the Straits settlements branch of the Royal Asiatic society, some startling facts are given concerning the waste resulting from this process. By actual experiment, Mr. Wray has found, first, that the wet bark which is now allowed to rot in the jungle contains fully 5.7% of its weight of gutta-percha, or, when dried, 11.4%; and secondly, that, by simply pounding and boiling the bark, nearly all this gum may be extracted. From the trunk of a tree, which he estimated to weigh 530 pounds in a wet state, he obtained but twelve ounces of gutta-percha by the ordinary Malay method, whereas, by boiling, 28 pounds more can be obtained; that is, for every pound collected, 37 pounds are wasted. It is stated that the export of gutta-percha from the Straits settlements and peninsula in 1875 reached the total weight of 10,000,000 pounds. From this it will be seen that there was no less than 300,000,000 pounds actually wasted, which represents £37,500,000 sterling. This estimate only includes the trunk, whereas the branches, and even the leaves, contain the gum. Such a wholesale waste of a material so vastly important to the world should be at once prevented if possible; and the question naturally arises, Can the bark be broken from the trees, and dealt with in the country, or can it be dried and sent to Europe to be worked over so as to be a commercial success?